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Popular Mechanics

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POPULARMECHANICS.COM MAY 2011

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SPACE**

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LUNAR FLYBYS

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PopMech
May

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the
cover

Going suborbital is just the start. Space tourism is developing at a faster pace than anyone could have imagined just a few years ago. Our cover illustration depicts the thrill and awe of the moments before launch. **Illustration by Matthew Laznicka.**

PHOTOGRAPH BY **DEAN KAUFMAN**

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PopMech on the iPad

Check out our latest issue in the App Store: itunes.apple.com/us/app/popular-mechanics-interactive/id393521916?mt=8



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Could a Sendai-size earthquake happen here in the U.S.? Experts say it's not a matter of if, but of when. The areas most at risk are not, as you'd expect, California's cities." PAGE 53

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Mar.

PM reader Chris Hawken, of Flint, Texas, gets the long view of his job—operating an oil rig that drills 8000 feet deep—with our March 2011 issue close at hand.

Odes to a Log Cabin

Thanks so much for the great coverage of our efforts to rebuild Titcomb Cabin in your March story "Cutting Class." It was awesome to see our work get such recognition. As much as I'd like to take all the credit myself, without the rest of the building crew—Max Friedman, Kate Bowman, Jordan Nesmith, Kodiak Burke, Lucas Schulz and our many student volunteers—the project would never have been completed. Thanks again for a great story.

GREGORY SOKOL THAYER SCHOOL OF ENGINEERING, HANOVER, N.H.

What an inspiring story—not least of all because of the determination the students showed. It's also refreshing

Nuclear Reaction

Your March story "Down in the Hole," about one of America's intercontinental ballistic missile facilities, brought back memories. From 1977 to 1981, I was stationed at the base you visited, Malmstrom, and worked on Minuteman missiles. My team members and I slept (or "roned") at the LCC India you wrote about. Reading the story, I felt like nothing had really changed in the 30 years since I served. Back then, knowing I was going to Montana was like getting a prison sentence, but now that I'm older, I look back on that time with fondness. I'm glad that I got a chance to see and work on our country's—as President Kennedy called it—ace in the hole. Thank you for the article.

MIKE JOHNSON ENDICOTT, N.Y.

While reading "Down in the Hole," I couldn't help thinking about the tax dollars our nation is wasting. Ever since the fall of the Soviet Union, I've hoped that U.S. leaders would reduce spending on protection from a nearly nonexistent threat. Hearing that the missiles' lives have been extended by 10 years brings a great sadness. Why support a defense we're very likely never to use?

GORDON EDWARDS SEQUIM, WASH.

to know that a group of college kids could put down their BlackBerries long enough to get their hands dirty on such a worthy project. I, for one, am trying to reduce the amount of time I spend with my TV, computer and other digital devices. There's something nice about how going low-tech once in a while slows down your life. One more thing about the story: I would have liked to see more of the how-to. I'm sure I'm not alone in having once dreamed of doing what those college kids did, and some diagrams and step-by-step instructions would've been a great addition to an already excellent story—even just to keep my dream alive.

ASIA YAVORSKY HAVESTRAW, N.Y.

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From our
fans and followers



Twitter nation, we salute you! Thanks to all of you who have tweeted recently about PM stories. A sampling:

@RivenCactus: Cool Garden Sheds by Pop Mechanics. I guess I'm a garden shed fan. This was fun to look at.

("Super Sheds," by Amanda DeMatto, April 2011)

@NanoSailID: Great comparison of solar sail vehicles in Popular Mechanics.

("Solar Sails Fly From Science Fiction Into Reality," by Sarah Fecht, popularmechanics.com)

@LittleMMI_Live: Get the latest Pop Mechanics ... There's an article on "How Your Gadgets Spy on You." Awesome!!

("Surviving the Digital Swarm," by Glenn Derene and Seth Porges, Feb. 2011)

@treesalldance: Both of my boys have magazine subscriptions. My 10-year-old car fanatic gets Pop Mechanics ...

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do you
think?

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Muscle-Car Showdown

Thank you for getting it right in your March article "Detroit vs the World." Having recently attended the Los Angeles Auto Show, I left with a completely new outlook on our bailed-out home-team auto manufacturers. One of the more impressive cars at the show was the Dodge Challenger—the same version you compared to the BMW M3. The fearsome-looking Dodge had a long queue of fans waiting to have their picture taken behind the wheel. Most were fairly young, not nostalgia-filled Boomers; kids were updating their Facebook pages on the spot, sharing their visceral Steve McQueen moments. On the other hand, the BMW display was a quiet place filled with silver cars barely discernible from the Mercedes "German taxis" parked on the same floor. What BMW has missed—and Dodge has nailed—are two important parameters of the muscle/performance market: looking cool and kicking butt. No matter how impressive, we don't want to be lectured about the nuances under the M3's hood. Sorry, but it looks no different from the relatively sedate BMW yuppie-mobiles overpopulating Apple Store parking lots. We want a car that screams, "There is no doubt I will leave you in a cloud of smoke when this light turns green." So, kudos to Detroit and Dodge for getting their mojo back and letting us burn rubber into the electric-car age.

BEN HORTON VENICE BEACH, CALIF.

I have to disagree with the results of the BMW M3 and Dodge Challenger showdown. You say the Dodge would win for its curb appeal and tie for its interior? The BMW has a much more sophisticated interior: The materials blow away the Dodge's. And curb appeal? I prefer the sleek BMW over the boxy Dodge. I know good aesthetics when I see them!

ADAM HARRISON STRONGSVILLE, OHIO

EDITOR'S NOTE: Your points are well taken, Adam. The BMW is a sweet Euro ride. But check out the new Mustang Boss on page 46, and see how you think that one stacks up to the BMW!

LARRY WEBSTER, AUTOMOTIVE EDITOR,
POPULAR MECHANICS

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Tech Watch

FUTURE OF AVIATION

Hiding in Plain Flight

Researchers with AeroVironment have finished a five-year Defense Department program to create a tiny, unmanned aerial surveillance vehicle that moves by flapping its wings like a hummingbird. "The idea was not to create a robotic hummingbird," says Matt Keennon, AeroVironment's project manager. "We wanted to make something that emulated the bird's flight dynamics." The main challenge was to enable the prototype to move like its biological namesake, zipping in any direction with precision and hovering by changing only the speed and angle of its wings. During test flights, the remote-controlled aircraft buzzed in and out of the doorway of



NANO HUMMINGBIRD *Weight (including payload):* 19 grams
Wingspan: 6.5 inches *Test speed range:* 0 to 11 mph

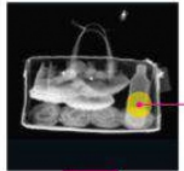
AeroVironment engineers say they need to make a number of improvements to the tiny aircraft before they can become effective indoor fliers:

- 1 Stronger batteries to provide longer flights while transmitting video;
- 2 Enhanced flight-stabilization systems that steady the craft as they meet

air turbulence around the buildings they access; 3 Collision-avoidance software to automatically dodge obstacles the controller can't see.

a building, beaming video. The company calls the Nano Hummingbird the first flapping aircraft capable of both hovering and forward flight that carries its own energy source. "This is a new form of man-made flight," Keennon says. AeroVironment painted its prototype with the bird's natural colors, highlighting possible covert uses of such tiny aircraft. — JOE PAPPALARDO

SAFE TRAVEL



New technology offers hope to thirsty fliers.

A scanner that screens the liquid inside almost any container may be adapted for use at airports, if a study funded by the Department of Homeland Security pans out. Matthew Augustine of the University of California, Davis, invented the machine, which can identify liquids by the telltale way their molecules rotate when exposed to magnetic waves. Augustine says he hopes to see such a scanner ready for the Transportation Security Administration within two years.

— SARAH FECHT

QUICK HITS



THE SMARTEST GLASSES IN THE ROOM

→ A new liquid-crystal technology is redefining the term bifocal. A tap on the side of the frame of emPower glasses, developed by

Virginia-based PixelOptics, turns the bottom of the plastic lenses into reading glasses by aligning liquid crystals to bend or refract light at angles that change the prescription. The wearer can trigger the same effect by tilting his head down. The company expects to sell the \$1200 glasses this year.

BRIDGING BROKEN SPINAL CORDS

→ When a spinal cord is severed, signals from the brain are cut off from muscles below the area of injury, but the neural pathways that carry and interpret those



signals remain intact. Now, researchers have shown in studies of rats that a jolt of electricity can activate those neural circuits and instruct the body to walk. Neuroscientists at UCLA recently created an "electronic spinal bridge" that connected the two ends of a rat's severed spinal cord. When the rodent moved both of its front

limbs in a walking motion, the action triggered a charge to the spinal cord, enabling the paraplegic animal's hind limbs to move without instruction from the brain. The researchers will try to tap latent motor patterns in damaged human spines, but they concede that adapting the system to bipeds will be difficult.

— ALEX HUTCHINSON

• ANCIENT WISDOM

Toes of the Pharaohs → Who invented the world's first prosthetic limb?

New experiments indicate that the accolade should be given to ancient Egyptians, who created functional fake toes. To be considered a true prosthesis rather than a cosmetic device, a replacement part must be lifelike, effective and tough enough for daily use. University of Manchester researcher Jacky Finch examined two museum relics from ancient Egypt that date to before 600 B.C., predating Roman fake legs by several hundred years. She tested replicas on sandal-wearing volunteers who had lost their big toes. The volunteers could walk using either replacement, but they found one of the models, which featured a hinge, to be more comfortable. The big toe, or hallux, carries 40 percent of the body's weight, making it vital to human gait. — JOE PAPPALARDO



This wood and leather toe, on display at the Egyptian Museum in Cairo, has a hinge that enabled users to walk comfortably. ▲

• CALAMITY'S LEGACY

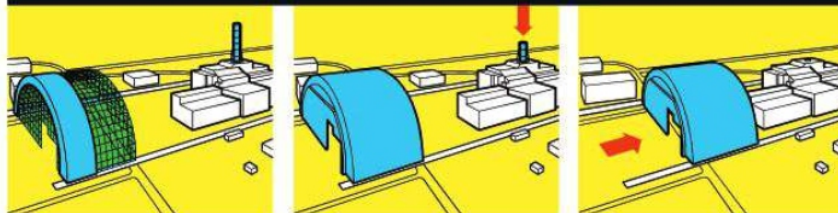
New Tomb for an Old Disaster

→ Containing a runaway nuclear reactor is a marathon, not a sprint. As the world watches Japan struggle to control the reactors at two earthquake- and tsunami-damaged nuclear power plants, engineers in the Ukraine are still dealing with the aftermath of the Chernobyl catastrophe.

Chernobyl's Reactor No. 4 exploded on April 26, 1986, spewing radiation across Europe. The shell that Soviet workers hastily erected to enclose the reactor has since cracked, releasing traces of radiation, and an international effort to build and place a new containment structure may soon begin construction. The \$2 billion-plus shield will include systems that remove heat from the damaged reactor and sensors that measure the new structure's integrity. It will also house four remotely operated cranes that will be used to dismantle parts of the facility. The design is finished, but the project remains underfunded. European Union nations so far have promised to cover half the cost; Russia, which controlled the Ukraine as part of the Soviet Union at the time of the disaster, has pledged just 1 percent.

As of press time, it's too early to tell whether the runaway Japanese reactors will breach safety barriers, but a thick shield (not included in Chernobyl's design) and the use of water to moderate the nuclear reaction (instead of Chernobyl's highly combustible graphite) have already prevented the cataclysmic dispersal of radioactive material. — J.P.

Officials fear the iron and concrete sarcophagus for Chernobyl's leaking Reactor No. 4 (above) could collapse. A new shield has been designed to last 100 years, presumably long enough for workers to dismantle the old facility. Here's how it will be built.

**1. Build the Frame**

A superstructure covered with a series of high-strength steel panels will be constructed adjacent to the existing sarcophagus.

2. Clear the Path

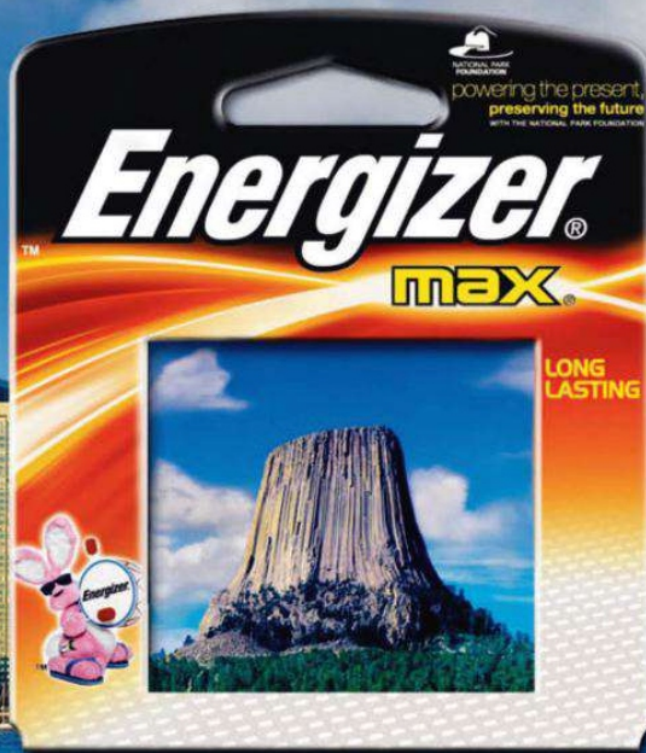
Workers will disassemble Reactor No. 4's signature ventilation chimney to accommodate the new 345-foot-tall shield.

3. Slide the Lid

The 20,000-ton shell, the largest moveable structure in the world, will slide over the old sarcophagus along railroad tracks.

EARTHQUAKES IN AMERICA: Can scientists see them coming? See page 53.

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PINPOINT LANDINGS

Rockets: Not Just for Takeoff Anymore

→ In order to land on a planet, moon or asteroid with very little atmosphere, spacecraft typically fire retrorockets to slow their descent. Craft designed to

return to Earth, however, have either been space planes that require long runways or capsules with parachutes that can drift for miles. Entrepreneurs are now building thrusters for NASA and private space firms that are adaptable enough to lower spacecraft to Earth. Such a rocket has to delicately adjust its angle of thrust to steer, but must also fire at high thrust in the moments before touchdown to keep the craft from crashing. Texas-based Armadillo Aerospace is adapting a rocket engine it developed for a moon-lander technology competition to operate in Earth's thick atmosphere and strong gravity. NASA will soon test Armadillo's lander, and the tourism firm Space Adventures has negotiated exclusive rights to use a similar design to set customers down on launchpads from suborbital space.

— MICHAEL BELFIORE



Mars

→ The Martian atmosphere is thin, so a combination of retrorockets and parachutes has been effective. NASA delivered two rovers to Mars by packing them in inflatable cushions that bounced to a halt.

LANDERS MUST BE TAILORED TO THEIR DESTINATIONS:

Asteroids

→ Setting down on most asteroids is not really landing—it's more like docking. The lack of gravity means anything on the surface will tend to float away, so instead of rockets, the craft would deploy a grapple to remain in place.

Venus

→ Venus has a very thick atmosphere, making parachutes a logical choice. The hour-long parachute descent seems straightforward, but the material must be tough enough to withstand sulfuric acid clouds and high winds.

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Nerves of Neon

→ One of the dangers in any operation is that the surgeon might nick a hidden nerve, leaving a patient in pain or even paralyzed. Scientists at the University of California, San Diego, have developed a way to make nerves glow so that surgeons can easily avoid them. The technique links a fluorescent peptide to a short chain of amino acids that attaches to nerves. The fluorescently labeled chain of amino acids is then injected into the patient's bloodstream. Initial tests on isolated human tissue proved the technique works, but further research will be required before the FDA allows clinical trials. Researchers say similar methods can make specific tumor cells light up with different colors, helping a surgeon determine which tissues to remove. — A.H.



MODERN CONSTRUCTION

Meet the Smashbot



→ Renovating large structures requires the delicate demolition of interior concrete walls and stairs. Now a new wave of robots adds speed and safety to such work sites. Stanley's F16 demolition robot, unveiled this year, can roll into tighter spaces than any of its predecessors and use an array of tools to wreak careful havoc on rebar and concrete. Just don't expect to see this tiny tank in home garages any time soon—prices start at \$135,000. — HARRY SAWYERS

1 Armed and Ready

Workers fit the robot's arm with attachments such as pavement-cracking impact chisels, rebar shears, hydraulic hand tools or 1500-lb drop hammers that can smash 1000 square feet of 8-inch reinforced concrete slab per hour. The Cracker, above, extracts busted concrete.

2 Extended Reach

Hydraulic cylinders enable the arm to reach 16.4 feet and rotate 360 degrees—unprecedented mobility for this type of tool. The arm articulates to conduct downward strikes or to reach overhead targets. Try doing that with a hand-operated jackhammer.

3 Getting Into the Job

The upper turret and boom can be removed so the machine can enter confined spaces. This feature, unique to the F16, enables the robot to do demolition work that would previously have required hydraulic pavement breakers, hand tools and sweat.

4 Well-Balanced Machine

Tank-like treads roll the 3417-pound carrier to the job. Four stabilizing outrigger legs raise the machine to a balanced operating position. A low center of gravity helps the relatively compact robot use tools formerly reserved for heavier machinery.

5 Clean Operator

An electric 25-hp motor allows the F16 to work indoors without filling the space with fumes. The operator uses a remote control to keep a safe distance. Happily missing from the day's work: a face full of concrete dust and hours of bone-shaking vibrations.



MANAGING HABITAT
There are many ways to protect habitat for fish populations. Aquatic plants provide oxygen, attract food and offer protection for fish in that pan fish can be some of the most delicious fish to eat.

A PAN FISH A DAY KEEPS...
Certain fish populations, even know all these fish are out there waiting for enough angling pressure, pan fish may overpopulate, resulting in a lot of very small fish. This phenomenon, called "overfishing," can be helped by anglers who take pan fish home and eat.

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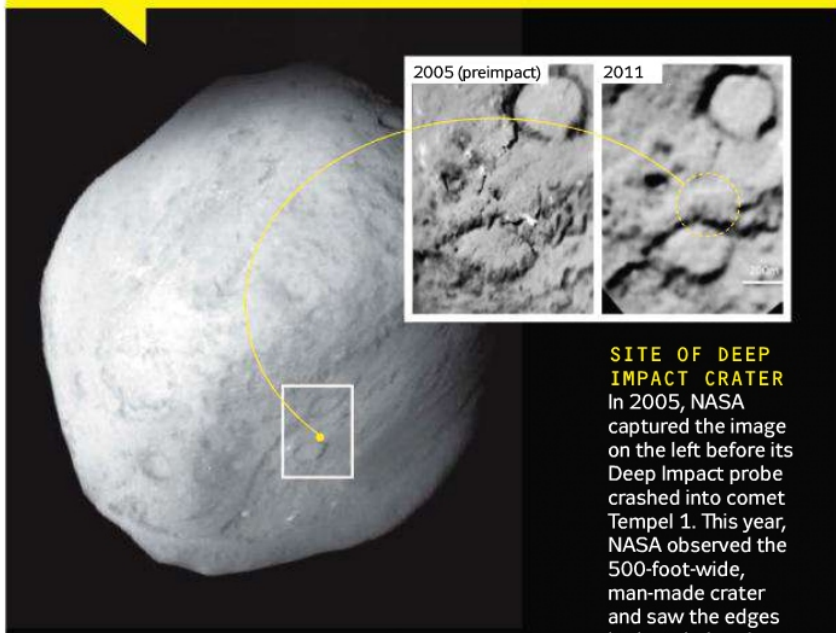


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MEANWHILE, IN OUTER SPACE . . .



SITE OF DEEP IMPACT CRATER

In 2005, NASA captured the image on the left before its Deep Impact probe crashed into comet Tempel 1. This year, NASA observed the 500-foot-wide, man-made crater and saw the edges had eroded, a sign that the surface is surprisingly delicate.

Return Ticket to a Comet

W**We're back!** In February, NASA's Stardust probe flew past Tempel 1, marking the first time a spacecraft has visited the same comet more than once. The probe captured 72 high-resolution images of the comet's surface, providing scientists with details on how it has changed since NASA's first visit in 2005. During the recent rendezvous, Donald Brownlee, co-investigator of the Stardust-NEXT mission (and a 2006 PM Breakthrough Award winner for the probe's first mission to comet Wild 2), also collected data on the cloud of debris streaming from the comet. "Comets lose tons of gas, rocks and dust into space each time they go around the sun," Brownlee says. Stardust used a dust monitor and two acoustic sensors to record 5000 tiny dust impacts to the craft in just 11 minutes. Brownlee estimates that twice as many impacts occurred outside the craft's monitored areas. The data supports what the new surface images revealed: Tempel 1 is more fragile than researchers had expected. "Instead of emitting individual little dust particles, comets emit chunks of porous, weakly held-together materials that just come apart and pulverize," Brownlee says. — ALLIE HAAKE

LOOKING FOR
LIFE IN ALL
THE RIGHT
PLACES

NASA scientists have announced that the Kepler space telescope found 68 possible Earth-size planets—the right size to produce

gravity that keeps water and gases adhered to a planet's surface—in a narrow segment of our Milky Way. Of these, five appear to be in their star's

"habitable zone," where the planets' temperatures are neither too hot to maintain surface water nor cold enough to freeze water entirely.

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Upgrade

Cloud Computer

→ Sometimes less really is more. A few things come to mind: haiku, golf scores and, not least of all, laptops, where extra ounces and inches are the enemy of portability and aesthetic perfection. At a mere 2.9 pounds and 0.6 inches thick, the 13-inch **Samsung 9 Series Laptop (\$1650)** is even svelter than Apple's previously thinnest-in-class MacBook Air. And this is no under-powered netbook. It has an Intel Core i5 processor, 4 GB of RAM and a 128 GB solid-state drive. The duralumin alloy (a material typically found in aircraft) shell should be able to take its share of dings, too. — *SETH PORGES*





Moveable Monitor

There are reasons keyboards sit on desks instead of being bolted to walls—for one, holding your hands upright for long stretches can be painful. But until now, using a touchscreen all-in-one PC required users to poke an upright surface (we've taken to calling this arm position *The Frankenstein*). Thankfully, the **HP TouchSmart 610 All-in-One PC (\$900)** obviates this ergonomic atrocity. Like a poolside lounge chair, the screen slides down by as much as 60 degrees, allowing users to type and tap in comfort. It's a monstrous improvement.

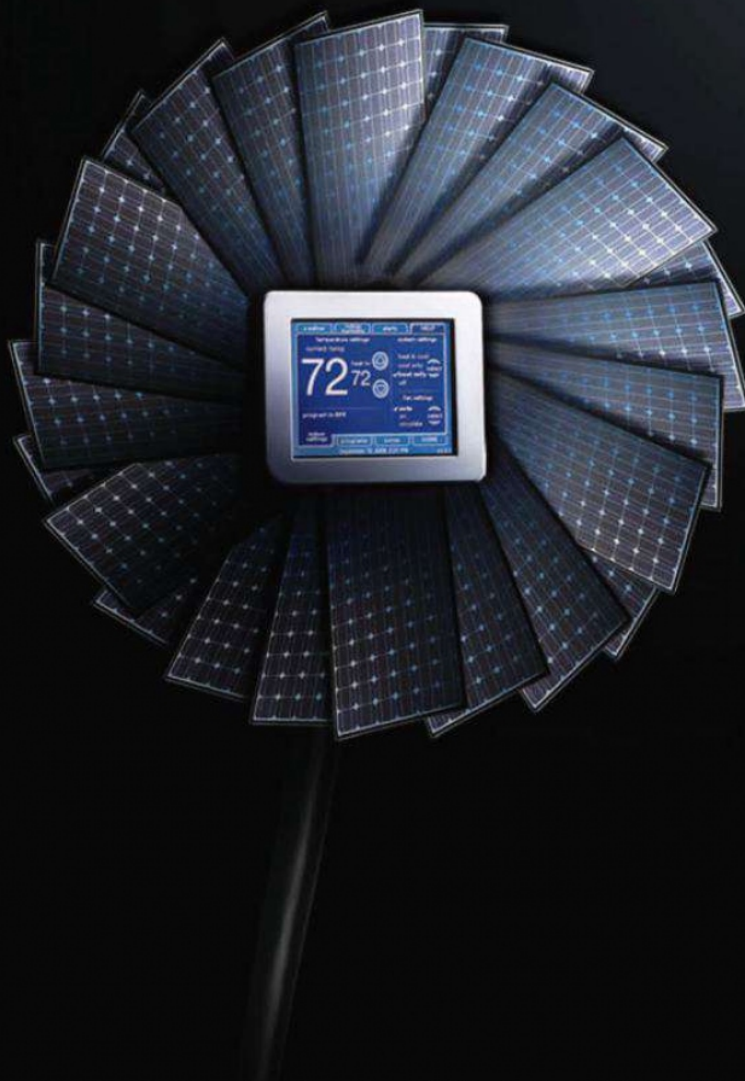
A Multitool With Bite

Forged from a single piece of stainless steel and more portable than a folding knife, the **Pocket-ToolX Piranha Multitool (\$50)** does decuple (that would be tenfold) duty with a toolbox's worth of wrenches, drivers, scrapers and openers. Of course, it won't replace your actual toolbox (what do you expect from something that can slide into your pants' front pocket?), but it's still a capable carry-anywhere tool for tightening a screw or prying open a can in a pinch.



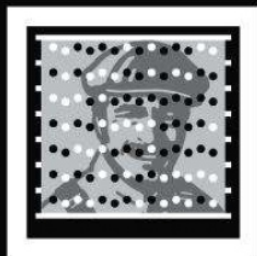
Loser's Helper

Even the most fastidious guy can still lose track of his keys or phone. Thank goodness for the **Cobra PhoneTag (\$60)**, a key chain that uses a Bluetooth link with your smartphone to cause the devices to chirp like a homing beacon if one drifts too far from the other. View it as a virtual buddy system: Your phone can help you find your lost keys, and your keys can help you find your lost phone.



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Shooting Range

↑ The optical zoom on most consumer cameras tops out at 10x or 12x—not exactly nearsighted, but definitely not enough for quality long shots. The lens on the 12-megapixel **Nikon Coolpix P500 (\$400)** makes most cameras seem like Mr. Magoo—its 36x optical zoom can move from a panoramic wide angle all the way in to a paparazzo-grade telephoto close-up. Unlike a full-fledged digital SLR, the P500 won't let you swap in a specialty lens. But with this kind of range, it's hard to imagine you'd ever need to.



Heat Alert

← Throwing a party can mean spending too long standing guard over the grill—and keeping the meat from burning—rather than enjoying time with your pals. The **iGrill Thermometer (\$100)** frees you from the cooker by beaming the food's temperature to an iPhone, iPad or iPod Touch, via a free app, up to 200 feet away. If you don't have an Apple device handy, no worries: An embedded digital display tracks the heat, and beeps when the target temperature is reached.

Let Them Eat Wake

The most impressive thing about the three-person **Yamaha 2011 VXR WaveRunner (starts at \$11,200)** isn't that it's one of the fastest PWCs on the market, easily reaching speeds of about 68 mph, or that its 1812-cc, four-cylinder four-stroke engine is the largest displacement powerhouse in the industry. No, what makes us fawn over this machine is that, despite its performance, it still weighs less than any seated PWC on the market, and costs thousands less than comparably powered wake-makers.



Very high triglycerides is a medical term for something serious:

TOO MUCH FAT IN YOUR BLOOD.

Ask your doctor about the FDA-approved medication made from omega-3 fish oil: **LOVAZA**

If you have high cholesterol, diabetes or are overweight you may also have very high triglycerides (≥ 500 mg/dL), which is a serious medical condition. LOVAZA, along with diet, has been clinically proven to lower very high triglycerides in adult patients. Individual results may vary. LOVAZA has not been shown to prevent heart attacks or strokes. It's purified. It's concentrated. And you can't get it at a health food store. Ask your doctor about LOVAZA—the prescription that starts in the sea.

LOVAZA is used along with a low-fat and low-cholesterol diet to lower very high triglycerides (fats) in your blood. Before taking LOVAZA, talk to your healthcare provider about how you can lower high blood fats by: losing weight if you are overweight, increasing physical exercise, lowering alcohol use, treating diseases such as diabetes and low thyroid (hypothyroidism), adjusting the dose or changing other medicines that raise triglyceride levels such as certain blood pressure medicines and estrogens.

Important Safety Information for LOVAZA

LOVAZA, along with diet, helps to lower very high triglycerides (≥ 500 mg/dL) in adult patients. Tell your doctor if you are allergic to fish or shellfish as LOVAZA may not be right for you. Talk to your doctor about any medical conditions you have and any medications you are taking, especially those that may increase your risk of bleeding. In some patients, LDL (bad) cholesterol may increase. Your healthcare provider should do blood tests before and during treatment with LOVAZA to check your cholesterol and triglyceride levels. If you have liver disease, you may require additional monitoring. Possible side effects include burping, infection, flu-like symptoms, upset stomach and change in sense of taste. How supplied: 1-gram capsule

Please see important Patient Information on the next page.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch, or call 1-800-FDA-1088.

For more information,
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Capsule shown not actual size

PATIENT INFORMATION
LOVAZA® (iō-vā-zā)
(omega-3-acid ethyl esters) Capsules

LOVAZA®
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Read the Patient Information that comes with LOVAZA before you start taking it, and each time you get a refill. There may be new information. This leaflet summarizes the most important information about LOVAZA and does not take the place of talking with your doctor about your condition or treatment.

What is LOVAZA?

LOVAZA is a prescription medicine, called a lipid-regulating medicine, for adults. LOVAZA is made of omega-3 fatty acids from oils of fish, such as salmon and mackerel. Omega-3 fatty acids are substances that your body needs but cannot produce itself.

LOVAZA is used along with a low-fat and low-cholesterol diet to lower very high triglycerides (fats) in your blood. Before taking LOVAZA, talk to your healthcare provider about how you can lower high blood fats by:

- losing weight, if you are overweight
- increasing physical exercise
- lowering alcohol use
- treating diseases such as diabetes and low thyroid (hypothyroidism)
- adjusting the dose or changing

other medicines that raise triglyceride levels such as certain blood pressure medicines and estrogens

Treatment with LOVAZA has not been shown to prevent heart attacks or strokes.

LOVAZA has not been studied in children under the age of 18 years.

Who should NOT take LOVAZA?

Do not take LOVAZA if you:

- are allergic to LOVAZA or any of its ingredients.

What should I tell my doctor before taking LOVAZA?

Tell your doctor about all of your medical conditions, including if you:

- drink more than 2 glasses of alcohol daily.
- have diabetes.
- have a thyroid problem called hypothyroidism.
- have a liver problem.
- have a pancreas problem.
- are allergic to fish and/or shellfish. LOVAZA may not be right for you.
- are pregnant, or planning to become pregnant. It is not known if LOVAZA can harm your unborn baby.
- are breastfeeding. It is not known if LOVAZA passes into your milk and if it can harm your baby.

Tell your doctor about all the medicines you take, including prescription and non-prescription medicine, vitamins, and herbal supplements. LOVAZA and certain other medicines can interact. Especially tell your doctor if you take medicines that affect clotting such as anticoagulants or blood thinners. Examples of these medicines include aspirin, nonsteroidal anti-inflammatory agents (NSAIDs), warfarin, coumarin, and clopidogrel (PLAVIX®).

How should I take LOVAZA?

- Take LOVAZA exactly as prescribed. Do not change your dose or stop LOVAZA without talking to your doctor.
- Your doctor should start you on a low-fat and low-cholesterol diet before giving you LOVAZA. Stay on this low-fat and low-cholesterol diet while taking LOVAZA.
- Your doctor should do blood tests to check your triglyceride and cholesterol levels during treatment with LOVAZA.
- If you have liver disease, your doctor should do blood tests to check your liver function during treatment with LOVAZA.

What are the possible side effects of LOVAZA?

The most common side effects with LOVAZA are burping, infection, flu

symptoms, upset stomach, and a change in your sense of taste.

LOVAZA may affect certain blood tests. It may change:

- one of the tests to check liver function (ALT)
- one of the tests to measure cholesterol levels (LDL-C)

Talk to your doctor if you have side effects that bother you or that will not go away.

These are not all the side effects with LOVAZA. For more information, ask your doctor or pharmacist.

What are the ingredients in LOVAZA?

Active Ingredient:

Omega-3-acid ethyl esters
Inactive Ingredients: Gelatin, glycerol, purified water, alpha-tocopherol (in soybean oil)

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Each month, the Popular Mechanics team takes every word and picture of the print issue, optimizes it for the iPad and adds interactive functionality to enhance the individual stories. The result? PopMech: a must-download app! This month you'll enjoy "15 Ways the Indianapolis 500 Changed the Way You Drive," our "Early Adopter's Guide to Space Travel" and "DIY Underground."

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The Tablet Wars

A

year ago, the iPad was considered novel and even a bit risky. After all, nobody really knew if tablets would fly off shelves—or wind up in a warehouse next to a stash of unsold Jar Jar Binks dolls. Well, millions of units and many, many millions of app downloads later, the iPad has become a cultural icon and a carry-everywhere companion for countless businessmen, gamers, book lovers and just about everybody. Of course, other companies want in on the action, which is why a flood of competing tablets are hitting the market. Always game for a fight, Apple released the iPad 2 in March. Thinner, faster and equipped with two cameras, here's how it stacks up against the competition. **BY SETH PORGES**



	Apple iPad 2 (\$500–\$830)	Motorola Xoom (\$600–\$800)	Samsung Galaxy Tab (\$250–\$500)	BlackBerry PlayBook (price not set)	HP TouchPad (price not set)
Operating System	iOS 4.3	Android 3.0	Android 2.2 (but should upgrade to 3.0 soon)	BlackBerry Tablet OS	webOS 3.0
Processor/RAM	1-GHz dual-core Apple A5/RAM not yet announced	1-GHz dual-core Tegra 2/1 GB	1-GHz Cortex A8/512 MB	1-GHz dual-core TI OMAP4430/1 GB	1.2-GHz dual-core Qualcomm Snapdragon/1 GB
Screen	768 pixels 9.7 in. 1024 pixels 4:3 aspect ratio	800 pixels 10.1 in. 1280 pixels 16:10 aspect ratio	600 pixels 7 in. 1024 pixels 16:9 aspect ratio	600 pixels 7 in. 1024 pixels 16:9 aspect ratio	768 pixels 9.7 in. 1024 pixels 4:3 aspect ratio
Bulk	1.3 pounds, 0.35 in. thick	1.6 pounds, 0.5 in. thick	0.84 pounds, 0.47 in. thick	0.9 pounds, 0.4 in. thick	1.6 pounds, 0.54 in. thick
Storage	16–64 GB	32 GB	16–32 GB	Not yet announced at press time	16–32 GB
Wireless Connectivity	Wi-Fi, optional 3G (Verizon or AT&T)	Wi-Fi, optional 3G, with free upgrade to 4G LTE (Verizon)	Wi-Fi, optional 3G (AT&T, Verizon, Sprint or T-Mobile), 4G LTE version coming soon	Wi-Fi, optional 4G WiMAX (Sprint)	Wi-Fi, optional 3G/4G (no carriers announced at press time)
HDMI Output	✓ (with optional \$39 accessory dongle)	✓	✓	✓	✗
Front/Rear Cameras	VGA/1 megapixel, 720p video	2 megapixels/5 megapixels, 720p video	1.3 megapixels/3.2 megapixels, 720p video	3 megapixels/5 megapixels, 1080p video	1.3 megapixels/no rear camera
BOTTOM LINE	Skipped the first iPad? The sequel's speedy processor and dual cameras might pull you across the checkout line. But buyer beware: There's always a better version around the corner, and we wouldn't be surprised if an iPad with 4G data and a higher-res screen drops soon.	The Xoom is the premier Android tablet, filled with features Apple left out of the first iPad. But the iPad 2's feature set could make the Xoom a tough sell for all but the most ardent Android devotees. And its price—more than most iPad 2 configurations—doesn't help.	When it first came out, in 2010, the Galaxy Tab was the iPad's only true competitor: Some consumers preferred the Tab's coat-pocket-size screen. Still, this is no budget alternative—its price (\$500 if you don't sign a data contract) is the same as the cheapest iPad 2.	In some ways, the PlayBook is more of a BlackBerry companion than a standalone tablet, given its ability to sync up with the iconic smartphone and mirror its data on a larger screen. And like the business-oriented phones, the PlayBook comes up short in the fun department.	Last year, HP shelled out \$1.2 billion for the flailing Palm for a reason—its webOS operating system has a lot to love. The TouchPad is the first tablet to use the platform, but it isn't scheduled to launch until summer. And by then, it may be too little, too late.

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→ ANALYSIS

The Rise of the Wallet Phone

BY GLENN DERENE



Could 2011 be the year we finally use our phones to pay for groceries? Maybe, thanks to near-field communication (or NFC), which uses short-range wireless signals to turn gadgets into digital wallets that can make payments with a simple swipe.

Such "contactless" payment systems aren't a new idea. NFC is a variation on radio-frequency-identification technology, and RFID-embedded credit cards have been available for years. Contactless credit cards got a tepid reception from consumers, so why the momentum around NFC? First: NFC is finally being built into mainstream gadgets such as Google's Nexus S smartphone and is widely expected to be a feature in Apple's next iPhone. Second: Major financial institutions are now pushing the tech as an alternative to traditional credit cards.

And the possibilities for NFC go far beyond quicker checkouts. With NFC, a single phone can switch between multiple credit card accounts, according to Jonathan Main, technical committee chair of the NFC Forum, a nonprofit formed in 2004 to support the technology. Location-aware smartphones could even deliver coupons for automatic redemption when NFC is used to pay.

But the big, unanswered question is security. RFID is hackable, and there's nothing inherent in NFC that makes it more secure. That means it's up to app developers and device-makers to build in encryption that protects consumers. After all, with NFC, a stolen phone could give criminals access to your personal life—and your bank account.

The PlayStation Phone

↓ Call it the iPhone effect, but it's becoming harder and harder for us to justify lugging a dedicated portable gaming device. Too bad for Sony, which offers powerful game systems to go, but none that also works as a phone. Well, until now. The **Sony Ericsson Xperia Play (price not set)** is the unholy hybrid of a PSP and a phone. It runs Android, has a 1-GHz processor and, unlike most phones—which hinder gaming functionality with their reliance on a touchscreen—features a slide-out control pad. Of course, with thousands of cheap-and-easy games already available for the iPhone and iPod Touch, the question remains: Is this too little, too late?



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\$30,000



Topless Delight

» **Just one model year** after the relaunch of the iconic Camaro, there's a droptop version arriving in time for spring. In a mere 20 seconds, the power-operated cloth top folds into the trunk and bathes the normally cavern-like interior with warm sunlight. Aside from their roofs, coupes and convertibles share nearly everything, from the 312-hp V6 and soulful 420-hp V8 to the lusty bodywork. Also, Chevy says engineers reinforced the droptop model's structure to handle the coupe's sporty suspension

settings. On mountainous roads near San Diego, the Camaro SS proved a comfortable cruiser until we booted the throttle and it responded with proper muscle-car thrust and engine roar. Except for an intermittently quivering steering column, the SS felt solid, and it attacked the corners with the same verve as the coupe. There's no loss of the Camaro's charismatic driving experience in the convertible version, and, starting at \$30,000, it's not a bad deal either.

— BEN STEWART



Ferrari Fighter

2012 McLaren MP4-12C

▶ Having made the epochal 1993 F1 supercar, F1 race team McLaren is again producing an exotic to take on the Ferrari 458. The chassis employs an innovative carbon-fiber tub and aluminum subframes. Under the carbon-fiber skin is a McLaren 3.8-liter twin-turbo V8 that routes 592 hp and 443 lb-ft of torque through a seven-speed twin-clutch gearbox. New tech includes hydraulically linked shocks, an "air brake" rear spoiler that flips vertical to slow the car, and a trail-braking system that feathers the rear inside brake to reduce cornering understeer. Engineers also obsessively counted kilograms, resulting in a roughly 3300-pound weight, hundreds less than the competition. All told, the MP4-12C is a heroic supercar, with fantastic steering feel and performance limits that made this writer giddy. Those clever driver aids never intrude, but simply combine for a sports car that's as manageable as it is quick. McLaren figures the \$229,000 12C will hit 205 mph and sprint to 60 mph in 3.2 seconds, yet it returns about 20 mpg. — ANDREW ENGLISH

ANYTHING BUT DULL

▶ Dramatically styled like Audi's A8 flagship, the new A6's exterior blends crisp character lines with taut surfacing and optional LED headlights. Forced induction appears in both available engines, the base

211-hp 2.0-liter four-cylinder turbo and the optional 310-hp 3.0-liter supercharged V6 with direct injection. While the 2.0-liter engine drives the front wheels via a CVT, the 3.0-liter uses Audi's signature quattro system and an

eight-speed automatic manufactured by ZF. On the island of Sicily, we drove the A6 V6 like we were auditioning to be Don Corleone's chauffeur. The V6 has the linear thrust of a V8. The responsive chassis understeers at the

limit but is basically neutral and surprisingly tossable. While quiet at a sedate cruise, the V6 emits a nice growl when pushed. If you're looking for a nondescript sedan, look elsewhere. — REX ROY



2011
Yamaha FZ8

NAKED AND SLIGHTLY NAUGHTY

▶ Literbikes score most of the glory when it comes to two-wheelers, but a growing middleweight movement is drawing attention to bikes that are lighter, nimbler and not quite as frighteningly powerful. Yamaha's new FZ8 (\$8490) goes back to basics with its no-frills feature list and minimal styling. Powered by a 779-cc inline four that revs to an impressive 11,500 rpm, the 467-pound FZ8 is tuned for low and midrange torque and is well-suited to the aluminum frame. During a day spent exploring Malibu's lesser-known

canyon back roads, the engine provided loads of smooth-spinning power, the chassis proved eminently flickable, and the dual-disc front brakes were more than up to the task at hand. Bikes like the Yamaha FZ8 take you back to that place where motorcycling is more about simple thrills than fear and frills, offering a refreshing alternative to the usual literbike suspects.

— BASEM WASEF

2012 Audi A6



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Future Fuel Miser

► The holy grail among mpg geeks is the “1-liter” car, a vehicle that can travel 100 kilometers on just 1 liter of fuel, which works out to 235 mpg. The XL1 is VW’s third 1-liter prototype, and it’s both the most practical and the least thirsty. VW claims it returns 261 mpg, but of course, there’s a catch: The XL1 is a plug-in hybrid—like the Volt—so its fuel use is supplemented by electrons. Still, it’s an exceedingly efficient package, with a small 47-hp diesel engine, a 27-hp electric motor and a 507-pound carbon-fiber chassis. On electric power, it’s positively sluggish, but with all guns blazing, the XL1 can run to 60 mph in about 12 seconds. It’s no sports car, but the 1752-pound weight and low center of gravity combine for nimble handling. The best part: VW is hinting that it might actually sell production versions of the XL1 by 2014. —ANDREW ENGLISH

2011 Nissan Quest



RETURNING QUEST

► Nissan is bullish on vans. In addition to introducing an all-new full-size van (see the NV), the company has redesigned the Quest minivan, which has been absent since 2009. Wrapped in less quirky sheet metal, the new

Quest uses the same front-drive architecture as the Nissan Maxima. Beginning at \$27,750 for the base S, all Quests use Nissan’s familiar 3.5-liter V6 mated to a CVT. With 260 hp and 240 lb-ft of torque, Nissan expects 19 mpg city, 24 mpg highway. Unlike

those in other minivans, the Quest’s third-row seats don’t fold into the rear cargo well, an odd omission. All seven passengers, however, will be supremely comfy in a van that favors a cushy ride over driver involvement. It’s a solid but far from superlative effort. —REX ROY



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LIPITOR is not for everyone. It is not for those with liver problems. And it is not for women who are nursing, pregnant or may become pregnant.

If you take LIPITOR, tell your doctor if you feel any new muscle pain or weakness. This could be a sign of rare but serious muscle side effects. Tell your doctor about all medications you take. This may help avoid serious drug interactions. Your doctor should do blood tests to check your liver function before and during treatment and may adjust your dose.

Common side effects are diarrhea, upset stomach, muscle and joint pain, and changes in some blood tests.

INDICATION:

LIPITOR is a prescription medicine that is used along with a low-fat diet. It lowers the LDL ("bad" cholesterol) and triglycerides in your blood. It can raise your HDL ("good" cholesterol) as well. LIPITOR can lower the risk for heart attack, stroke, certain types of heart surgery, and chest pain in patients who have heart disease or risk factors for heart disease such as age, smoking, high blood pressure, low HDL, or family history of early heart disease.

LIPITOR can lower the risk for heart attack or stroke in patients with diabetes and risk factors such as diabetic eye or kidney problems, smoking or high blood pressure.

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LOWERING YOUR HIGH CHOLESTEROL

High cholesterol is more than just a number, it's a risk factor that should not be ignored. If your doctor said you have high cholesterol, you may be at an increased risk for heart attack and stroke. But the good news is, you can take steps to lower your cholesterol.

With the help of your doctor and a cholesterol-lowering medicine like LIPITOR, along with diet and exercise, you could be on your way to lowering your cholesterol.

Ready to start eating right and exercising more? Talk to your doctor and visit the American Heart Association at www.americanheart.org.

WHO IS LIPITOR FOR?

Who can take LIPITOR:

- People who cannot lower their cholesterol enough with diet and exercise
- Adults and children over 10

Who should NOT take LIPITOR:

- Women who are pregnant, may be pregnant, or may become pregnant. LIPITOR may harm your unborn baby. If you become pregnant, stop LIPITOR and call your doctor right away.
- Women who are breast-feeding. LIPITOR can pass into your breast milk and may harm your baby.
- People with liver problems
- People allergic to anything in LIPITOR

BEFORE YOU START LIPITOR

Tell your doctor:

- About all medications you take, including prescriptions, over-the-counter medications, vitamins, and herbal supplements
- If you have muscle aches or weakness
- If you drink more than 2 alcoholic drinks a day
- If you have diabetes or kidney problems
- If you have a thyroid problem

ABOUT LIPITOR

LIPITOR is a prescription medicine. Along with diet and exercise, it lowers "bad" cholesterol in your blood. It can also raise "good" cholesterol (HDL-C).

LIPITOR can lower the risk of heart attack, stroke, certain types of heart surgery, and chest pain in patients who have heart disease or risk factors for heart disease such as:

- age, smoking, high blood pressure, low HDL-C, family history of early heart disease

LIPITOR can lower the risk of heart attack or stroke in patients with diabetes and risk factors such as diabetic eye or kidney problems, smoking, or high blood pressure.

POSSIBLE SIDE EFFECTS OF LIPITOR

Serious side effects in a small number of people:

- **Muscle problems** that can lead to kidney problems, including kidney failure. Your chance for muscle problems is higher if you take certain other medicines with LIPITOR.
- **Liver problems.** Your doctor may do blood tests to check your liver before you start LIPITOR and while you are taking it.

Call your doctor right away if you have:

- Unexplained muscle weakness or pain, especially if you have a fever or feel very tired
- Allergic reactions including swelling of the face, lips, tongue, and/or throat that may cause difficulty in breathing or swallowing which may require treatment right away
- Nausea, vomiting, or stomach pain
- Brown or dark-colored urine
- Feeling more tired than usual
- Your skin and the whites of your eyes turn yellow
- Allergic skin reactions

Common side effects of LIPITOR are:

- Diarrhea
- Muscle and joint pain
- Upset stomach
- Changes in some blood tests

HOW TO TAKE LIPITOR

Do:

- Take LIPITOR as prescribed by your doctor.
- Try to eat heart-healthy foods while you take LIPITOR.
- Take LIPITOR at any time of day, with or without food.
- If you miss a dose, take it as soon as you remember. But if it has been more than 12 hours since your missed dose, wait. Take the next dose at your regular time.

Don't:

- Do not change or stop your dose before talking to your doctor.
- Do not start new medicines before talking to your doctor.
- Do not give your LIPITOR to other people. It may harm them even if your problems are the same.
- Do not break the tablet.

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- Ask your doctor or health care provider.
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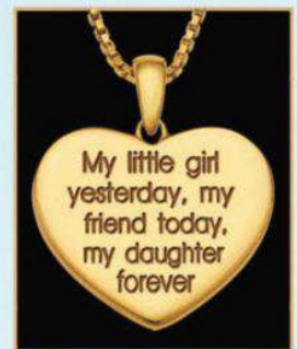
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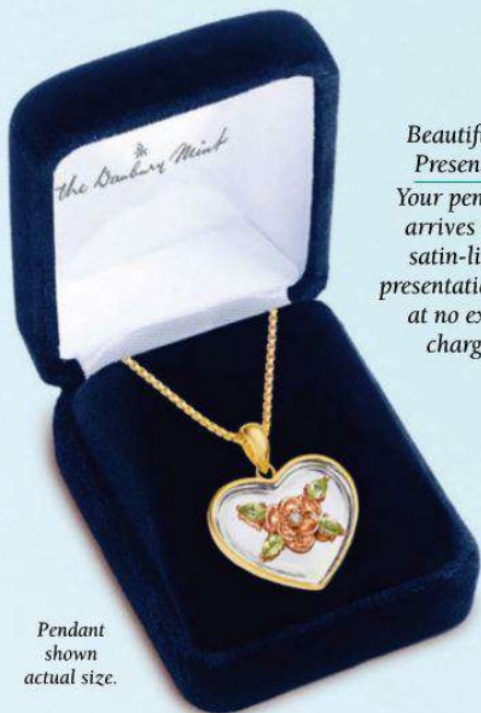
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2011 Chevrolet Cruze Eco

**ECO-MODDER**

▶ The Chevy Volt may be grabbing headlines, but high fuel efficiency doesn't require expensive electric hardware. Take the \$18,995 Cruze Eco, which uses a combination of aerodynamic tweaks (for instance, automatic shutters close the grille to reduce

drag), powertrain mods and lighter components to boost mileage deep into the 40s. The EPA rates the Eco at 42 mpg highway, but on a 125-mile trek between L.A. and San Diego, the car's computer said we averaged 48.6 mpg. No doubt the standard six-speed manual gearbox's tall

gearing played a role. There's little penalty for this efficiency—the engine pulls adequately, the car feels solid and refined, and it even rides better than Cruzes wearing 18-inch tires. The Eco may not be a hybrid, but its cost-effective engineering is just as impressive.

—BEN STEWART

POSH HYBRID

▶ Infiniti's first hybrid sandwiches a 67-hp electric motor between a 3.5-liter V6 and seven-speed automatic transmission. Two computer-controlled clutches isolate the electric motor, so the M Hybrid can drive solely on electric power at speeds of up to 62 mph for

roughly a mile. The system also aggressively recaptures braking energy, and engineers claim that in city driving, the M35h remains in EV mode for about half the time. The M Hybrid, however, blends the two power sources to return an estimated 27/32 mpg, with a combined figure (29 mpg) that's

a whopping 38 percent better than the V6 model. Even better, the M35h rips off the line—thanks to a combined 360 hp—with V8-like authority. The usual Infiniti sporting demeanor and luxury touches remain, including the optional Lane Departure Prevention system and other driver aids. —B. S.



2012 Infiniti M35h

2012 Nissan NV

*New Carryall*

▶ The commercial van, the usually sleepy market segment favored by plumbers and conversion-van builders, now has a new player. Nissan joins the fray with the NV (for "Nissan Van"), a full-size van that's built in the U.S. alongside the Titan and Armada trucks. Nissan knows it is aiming to please a notoriously demanding consumer: "There is no more dissatisfied customer," says product planning VP Larry Dominique. "Most users hate their vans." The NV's 216-hp V6, the 317-hp V8 and the five-speed auto are familiar Titan parts, but neither sheet metal nor the fully boxed frame of the NV is shared with the passenger truck. As a new entrant, the NV applies fresh ideas to old problems. For example, the NV's pickup-like cabin is both easier to enter and more comfortable than a traditional van's, with no transmission doghouse intruding, and the rear-door hinges are especially beefy to withstand abuse. Prices range from just under 25 grand to over 35 for a loaded 3500HD. —KEVINA WILSON



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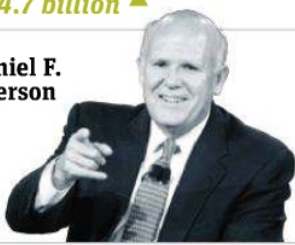
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Big Three Score Card

Chrysler, Ford and GM are no longer on their knees: Sales are up and optimism is growing. But how well are the Big Three positioned for the long haul? A comparison. *BY DAVID KILEY*

	 • CHRYSLER	 • FORD	 • GM
2010 FINANCIAL PERFORMANCE	 -\$652 million	 +\$6.6 billion	 +\$4.7 billion
CEO	 Sergio Marchionne	 Alan R. Mulally	 Daniel F. Akerson
STRENGTHS	Strong design and engineering talent at Chrysler and sister company Fiat. CEO and senior team are moving fast to deliver new cars and trucks and improve quality. TV commercials deserve an Oscar.	Ford's quality has essentially matched Japanese brands, says <i>Consumer Reports</i> . Pickups remain a top seller. The big bet on appealing small cars, like the Fiesta and Focus, is about to pay off as gas prices rise.	Efficient product development throughout the world. Quality is improving. Just four brands to manage in the U.S., down from eight. Strong in China. Buicks and Cadillacs are turning heads.
WEAKNESSES	The new cars, like the Grand Cherokee, are terrific and quality is improving, but they're climbing a hill. Dodge and Chrysler brands have low trust among consumers.	Except for limo companies, no one's clamoring for a Lincoln. The Flex and new Taurus haven't caught on.	The government still owns 33 percent, and GM is again boosting incentives to sell cars. The management team has yet to prove it can make the right product investments.
TALENT POOL/ RISING STAR	Ralph Gilles is head of both design and the Dodge brand, and has rapidly improved the cars' cabins and exteriors.	Ford Americas president Mark Fields is establishing himself as logical next CEO. Asia Pacific chief Joe Hinrichs and global marketing boss James Farley make a solid bench.	Tough to say because of high turnover among GM's executives, but North America president Mark Reuss , a well-known car guy and GM lifer, could be next in line.
HALO CAR	 Chrysler 300C	 Ford Mustang Boss	 Chevy Volt
ANCIENT WARHORSE	Dodge Caliber	Lincoln Town Car	Chevy Impala
NEXT BIG RIDE	Alfa Romeo	Revitalized Lincoln	Cadillac XTS
STREET BUZZ	CEO Marchionne is tough and smart. The return of charismatic cars from Fiat and, soon, Alfa Romeo will, we hope, beat back blandness. But quality is still the wild card.	Rather than lose ground fighting bankruptcy, Ford continues its momentum. Mulally's successor needs to be identified so as not to distract from progress.	Signs of old GM arrogance linger on. Pundits grumbled when the key job supervising new vehicle development went to former human resources head Mary Barra.
BOTTOM LINE	Based on Chrysler's two previous brushes with liquidation, the company thrives on adversity. Don't bet against a heroic comeback.	Bailed-out Chrysler and GM washed away billions in debt during bankruptcy, but Ford is honoring its obligations and making more money, and has arguably the best lineup in Detroit.	GM is the top-selling foreign brand in the world's largest car market—China. If it can follow the Volt and Cruze with similar class-leading cars, it could once again be the global leader.



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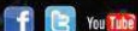
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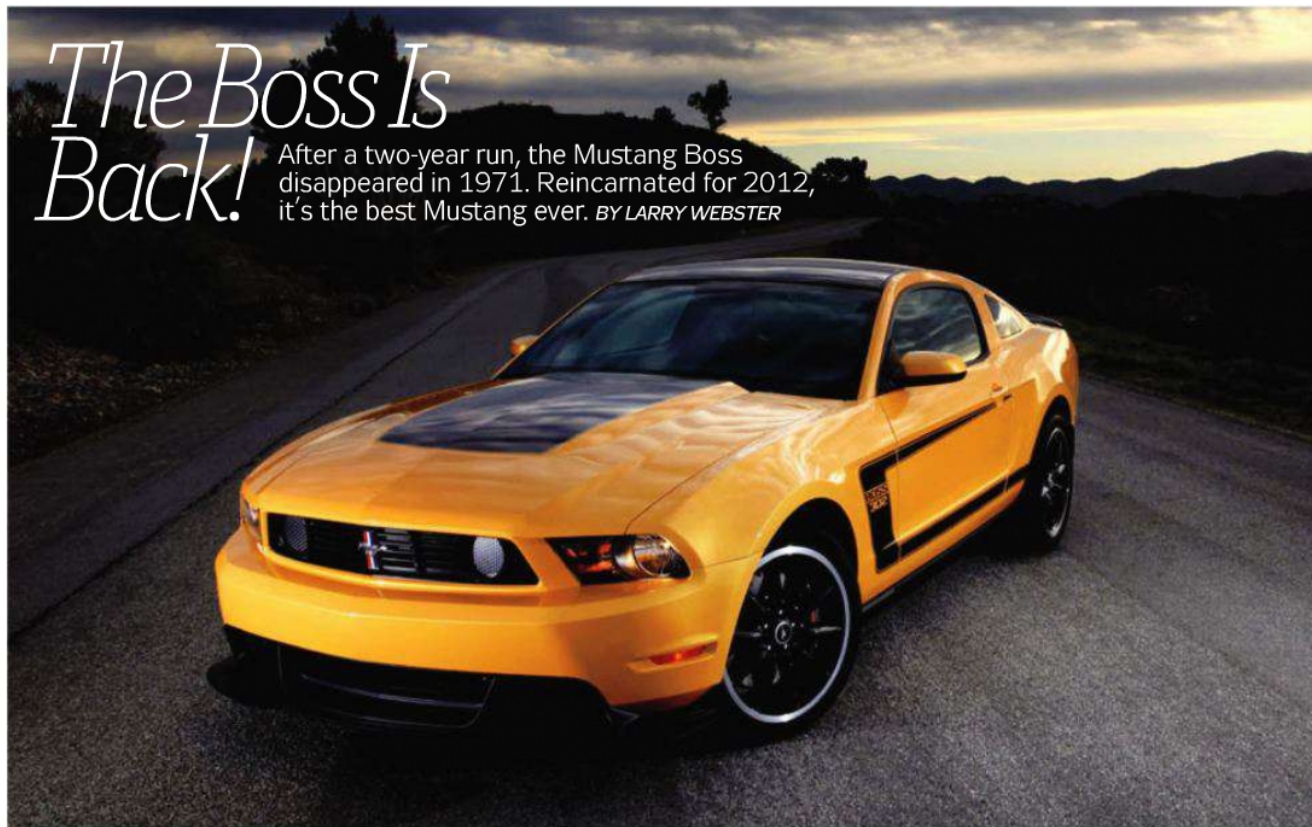
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The Boss Is Back!

After a two-year run, the Mustang Boss disappeared in 1971. Reincarnated for 2012, it's the best Mustang ever. BY LARRY WEBSTER



The octopus-like exhaust of the Mustang Boss says as much about this high-performance ponycar as the 444-hp V8 under the hood. In addition to the usual dual rear exhaust, the Boss has two additional gas-escape ports—one in front of each rear wheel. They exist simply to waft more of the sonorous V8's soundtrack into the cabin and are just another exquisite detail adding up to the best muscle-car experience available today.

Despite the booming exhaust, it's easy to underestimate this car—it's only got 32 more horsepower than the Mustang GT. But the Boss's engine has several internal changes—forged aluminum pistons, a lighter valvetrain and a taller intake plenum—that make it higher-revving (7500 rpm) and more responsive (we recorded a 0-to-60-mph time of just 4.6 seconds). Plus, engineers overhauled the chassis with stiffer springs, five-position adjustable shocks, grippier tires and upgraded brakes.

We drove the Boss both at California's Laguna Seca raceway—a supremely challenging circuit—and on the mountain roads nearby. On the track, it was an animal, confidently attacking turns with a neutral handling balance and then sure-footedly maintaining traction at corner exits. The brakes remained strong despite repeated hot laps (navigating Turn Two requires slowing from 120 mph down to 50) and offered precise feel.

Drivers can adjust the effort of the electrically assisted steering with three settings that range from firm to quite light. In all settings, you can readily detect the road texture and discern available grip. So even when navigating mountain-road turns lined with certain-death drop-offs, we could confidently push the Boss as if we had been driving a Miata.

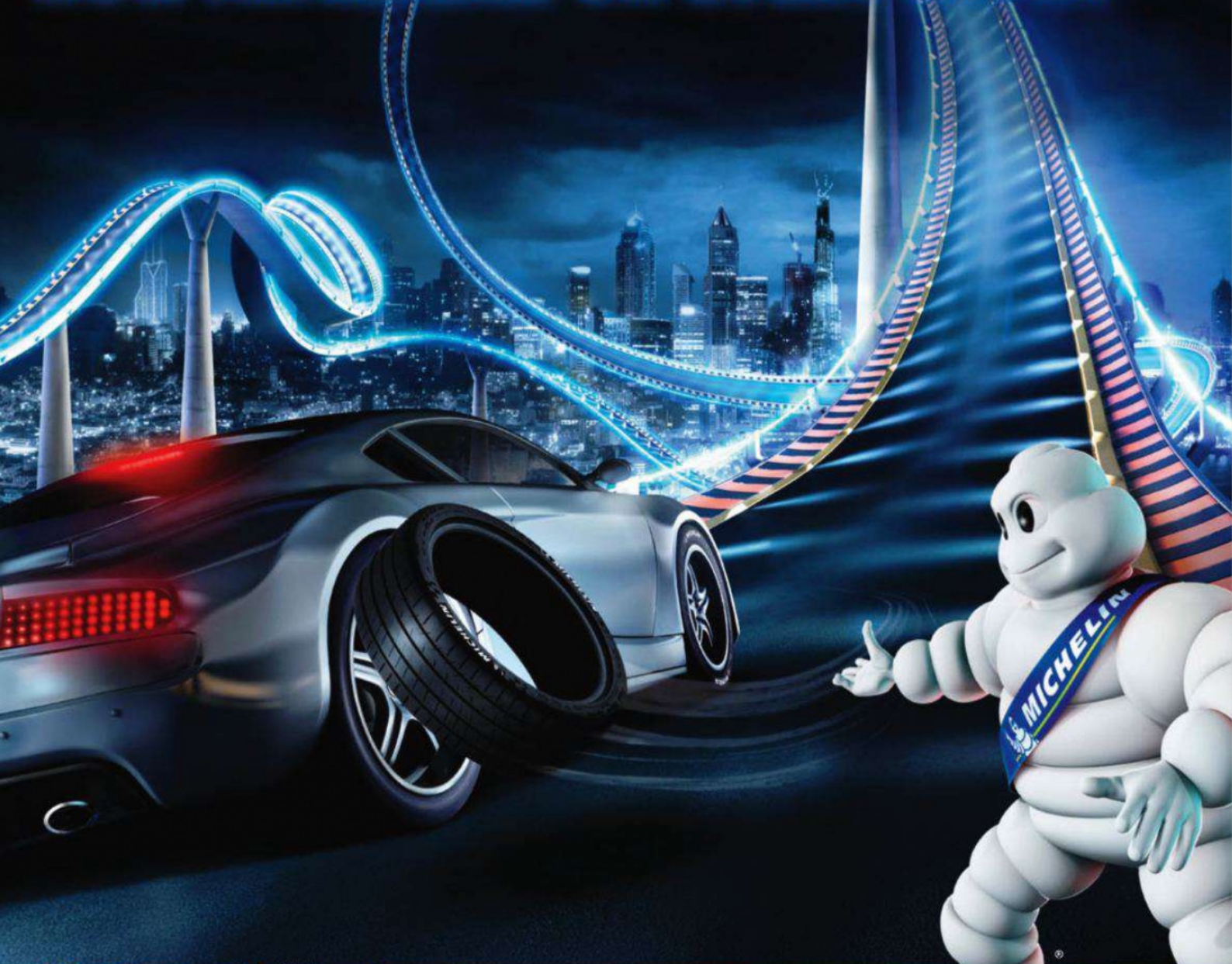
We see only two downsides: The Sync infotainment system isn't available. And the ride is a bit firm. That's a worthwhile tradeoff for the track capability, but the Boss clops on some freeway slabs. Regardless, we have nothing but enthusiasm for this car. It's a low-cost rival to the BMW M3, an expert in all performance driving environments and absurdly fun to drive.

Price (base/as tested)	\$40,145/\$42,140
Powertrain	444 hp/380 lb-ft 5.0-liter V8/6M
Wheelbase (inches)	107.1
Length (inches)	188.1
Curb weight (pounds)	3632
Acceleration (0–60 mph)	4.6 sec
Acceleration (¼-mile)	12.79 sec @ 113.59
Braking (60–0 mph)	107.8 ft
Skidpad (g's)	1.01
Fuel economy (mpg)	17 city/26 hwy



For the racetrack-obsessed, Ford offers the \$6995 Laguna Seca package. It ditches the rear seat for extra chassis bracing, and includes stiffer suspension, even stickier tires, brake- and transmission-cooling ducts and a huge front splitter.

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1- Based upon commissioned 3rd-party testing conducted by TÜV Automotive and DEKRA Test Center of MICHELIN® Pilot® Super Sport vs. Bridgestone® Potenza™ RE050A, Continental® ContiSportContact™ 3, Dunlop® SP Sport Maxx® GT, Goodyear® Eagle® F1 Asymmetric, and Pirelli® PZero™ 2 - Some vehicles come from the vehicle manufacturer with "split fitments" - meaning different size tires on the front vs. the rear. Because these tires cannot be rotated as recommended by Michelin, the mileage warranty on each rear tire will cover half the number of miles as the standard mileage warranty for that particular tire. ©2011 Michelin North America, Inc. All Rights Reserved.

Aerodynamic Original

> BY JAY LENO

> PHOTOGRAPHS BY JOHN LAMM

E

EVER HEAR OF THE TATRA?

I didn't think so.

An expensive Czech equivalent to a Cadillac, the streamlined Tatra T87 was very fast for its day, with a top speed of 103 mph. But not many were sold outside Czechoslovakia. It's hard to sell something before its time.

My Tatra T87 sedan was built in the small city of Koprivnice, in 1938. It's powered by a rear-mounted, cast-magnesium, air-cooled 2.9-liter overhead-cam Hemi-head V8 with a four-speed transaxle. The suspension is fully independent, with twin transverse leaf springs in front and a unique swing axle setup in back.

People go nuts for Tucker cars these days—they sell for over a million dollars—but the Tatra was developed a good 10 years before the Tucker, and it was much more advanced. It had a V8, not a flat six, and it didn't use somebody else's engine or transmission. The Tatra is really what the Tucker should have been—a truly aerodynamic car that got 20 mpg at 60 mph. In the

'30s, fuel consumption for most big six-passenger cars was 6 to 9 mpg.

Founded in 1850 under a different company name that nobody here can pronounce, Tatra built carriages and wagons for decades. Then, in 1897, it became a carmaker, now the world's third oldest after Mercedes-Benz and Peugeot. Tatra built automobiles until 1999, then switched to manufacturing trucks, which it still does.

The company's original engineers were two Austrians: Hans Ledwinka, who almost never built anything the way anyone else did, and designer Edmund Rumpler. In the 1930s—after a brief fling with a 12-cylinder, front-engine car—Ledwinka began working with his son Erich to build Tatra sedans with air-cooled, rear-mounted

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JAY LENO'S GARAGE///
T87 TATRA

V8 engines.

In 1934, the company obtained a license from Paul Jaray, the Hungarian designer of the *Graf Zeppelin*, to build the Type 77, a full-size fastback. When the Tatra team tested a model in a wind tunnel, its coefficient of drag was 0.24. When they tested a prototype, the Cd was 0.36. The norm for most cars of that era: 0.54.

Ledwinka's 1936 Tatra T97 had a rear-mounted, air-cooled four-cylinder boxer-type engine; a central-structural-tunnel floor pan; rear-wheel drive; four seats; and a luggage compartment located under the hood. Two years later, when the first Volkswagen Beetle was introduced, Ledwinka brought a lawsuit against the manufacturer and its designer, Ferdinand Porsche, over the similarities between the two vehicles. When the Germans annexed Czechoslovakia in 1938, the suit was dropped.

After the war ended, the Soviets trumped up charges that Ledwinka had collaborated with the Nazis and jailed him for six years. The lawsuit was revived, and Volkswagen had to pay Tatra about 3 million deutsche marks. Ledwinka never got a pfennig of the settlement—but he had the satisfaction of being the only person who ever sued Porsche and won.

When I first saw the T87, 20 years ago at a car show, I told the owner to call me if he ever wanted to sell it. After he passed away, I got the call. When I went to see the family, they told me exactly what they wanted for the car, and I paid exactly what they asked. I always say, you don't pay too much, you just buy too soon.

We went through the motor, installed new rods and pistons and made some changes. Tatra kept the output at 74 horsepower for reliability. I put a 2-bbl Weber on it, as opposed to the standard carburetor. I can always go back. But you get better mileage—and about 85 hp—with the Weber, and it looks totally stock. That big fin helped high-speed stability, but you can't see out of the rear very



Left: The T87's sophisticated styling included plenty of room for passengers and a beautiful art deco dash. Below: An air-cooled V8 enabled 100 mph, making it an autobahn burner favored by German military officers.



well, so we installed outside mirrors.

My T87 is mechanically different from any other automobile I own. It has a rigid tubular-backbone chassis. Instead of constant-velocity joints, the car has two crown-wheel gears—one on each rear-axle shaft—that pivot around a pair of differential spur gears. The two spare tires are in front, an attempt to equalize weight distribution, but since the engine and gearbox are at the rear, the T87 is still tail-heavy and has a tendency to spin at the slightest provocation. A British automotive writer, Gordon Wilkins, said that driving a Tatra produces "the uneasy exhilaration which may be got from shampooing a lion."

I drive it swiftly, but I'm aware of its handling characteristics, and I don't lift off the throttle in a corner. It's like driving an early Porsche 356, with that car's tendency for the rear end to step out, but the Tatra is twice

as long. When you go down the road, there's a motorboat sort of feel to the T87, but not disconcertingly so. The steering is so light, you can steer with one finger. When you lift off the gas at 60 mph, you don't get that *braaaahhhh* overrun. It doesn't free-wheel; it cuts aerodynamically through the wind so well, it barely slows down.

Here's the best part: One day I got a call from a guy in the U.K.

"We have a Tatra club," he said. "There's a newsletter and a spare-parts scheme. We're trying to put this and that together."

"Oh," I said, "I'd love to join."

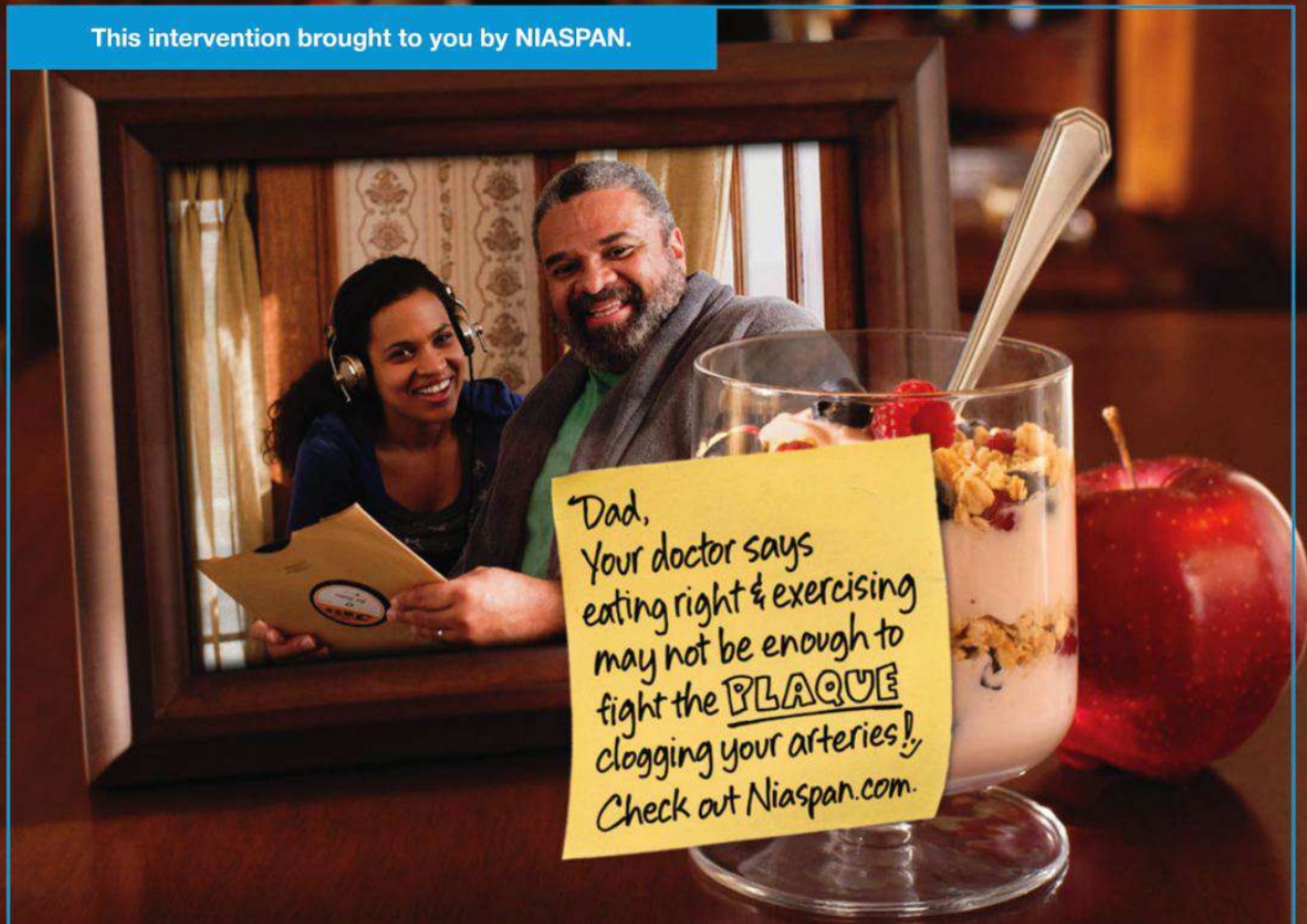
"We'd love to have you," he replied.

I said, "How many people do you have in the club?"

"With your membership now," he said, "there's four!"

Well, I thought, they won't need a big room for the Christmas party. **PM**

This intervention brought to you by NIASPAN.



Even with diet and exercise, plaque can build up in the heart's arteries.

If you have high cholesterol and coronary artery disease, NIASPAN, along with diet and a bile acid-binding resin (another cholesterol medicine), is FDA-approved not only to slow down plaque buildup, but to actually help clear some of it away.



High cholesterol is one risk factor that leads to plaque buildup. Other factors include: family history of early heart disease, high blood pressure, smoking, and diabetes.

NIASPAN, with a bile acid-binding resin, has not been shown to prevent heart disease, heart attacks, or stroke.

If you cannot afford your medication, contact:
www.pparx.org or call the toll-free number
1-888-4PPA-NOW (1-888-477-2669) for assistance.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch, or call 1-800-FDA-1088 (1-800-332-1088).

Text NIASPAN2 to 80800 for more information*

Visit niaspan.com or call 1.877.NIASPAN for more information.

*Message and data rates may apply.

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IMPORTANT SAFETY INFORMATION FOR NIASPAN

- Prescription NIASPAN should not be taken by people with stomach ulcers, liver or serious bleeding problems
- **Severe liver damage can occur when switching to a long-acting niacin, such as NIASPAN, from immediate-release niacin**
- Blood tests are needed before and during treatment with NIASPAN to check for liver problems
- Contact a health care provider if serious side effects such as unexplained muscle pain, tenderness or weakness develop. The risk of these side effects may be higher when taking NIASPAN with a statin
- Tell your health care provider if you have a history of gout, drink large amounts of alcohol, or if you are diabetic and experience increases in blood sugar
- The most common side effect of NIASPAN is flushing (warmth, redness, itching, and/or tingling of the skin)

Please see the next page for brief summary of full Prescribing Information.



Fight back. Fight plaque.

INDICATIONS AND USAGE Therapy with lipid-altering agents should be only one component of multiple risk factor intervention in individuals at significantly increased risk for atherosclerotic vascular disease due to hyperlipidemia. Niacin therapy is indicated as an adjunct to diet when the response to a diet restricted in saturated fat and cholesterol and other nonpharmacologic measures alone has been inadequate.

1. NIASPAN is indicated to reduce elevated TC, LDL-C, Apo B and TG levels, and to increase HDL-C in patients with primary hyperlipidemia and mixed dyslipidemia.
2. NIASPAN in combination with simvastatin or lovastatin is indicated for the treatment of primary hyperlipidemia and mixed dyslipidemia when treatment with NIASPAN, simvastatin, or lovastatin monotherapy is considered inadequate.
3. In patients with a history of myocardial infarction and hyperlipidemia, niacin is indicated to reduce the risk of recurrent nonfatal myocardial infarction.
4. In patients with a history of coronary artery disease (CAD) and hyperlipidemia, niacin, in combination with a bile acid binding resin, is indicated to slow progression or promote regression of atherosclerotic disease.

Limitations of Use No incremental benefit of NIASPAN coadministered with simvastatin or lovastatin on cardiovascular morbidity and mortality over and above that demonstrated for niacin, simvastatin, or lovastatin monotherapy has been established.

CONTRAINDICATIONS NIASPAN is contraindicated in the following conditions:
 • Active liver disease or unexplained persistent elevations in hepatic transaminases [see Warnings and Precautions]
 • Patients with active peptic ulcer disease
 • Patients with arterial bleeding
 • Hypersensitivity to niacin or any component of this medication [see Adverse Reactions]

WARNINGS AND PRECAUTIONS NIASPAN preparations should not be substituted for equivalent doses of immediate-release (crystalline) niacin. For patients switching from immediate-release niacin to NIASPAN, therapy with NIASPAN should be initiated with low doses (i.e., 500 mg at bedtime) and the NIASPAN dose should then be titrated to the desired therapeutic response.

Caution should also be used when NIASPAN is used in patients with unstable angina or in the acute phase of an MI, particularly when such patients are also receiving vasoactive drugs such as nitrates, calcium channel blockers, or adrenergic blocking agents.

Niacin is rapidly metabolized by the liver, and excreted through the kidneys. NIASPAN is contraindicated in patients with significant or unexplained hepatic impairment [see Contraindications and Warnings and Precautions] and should be used with caution in patients with renal impairment. Patients with a past history of jaundice, hepatobiliary disease, or peptic ulcer should be observed closely during NIASPAN therapy.

Skeletal Muscle Cases of rhabdomyolysis have been associated with concomitant administration of lipid-altering therapy (≥1 g/day) of niacin and statins. Physicians contemplating combined therapy with statins and NIASPAN should carefully weigh the potential benefits and risks and should carefully monitor patients for any signs and symptoms of muscle pain, tenderness, or weakness, particularly during the initial months of therapy and during any periods of upward dosage titration of either drug. Periodic serum creatine phosphokinase (CPK) and potassium determinations should be considered in such situations, but there is no assurance that such monitoring will prevent the occurrence of severe myopathy.

The risk for myopathy and rhabdomyolysis are increased when lovastatin or simvastatin are coadministered with NIASPAN, particularly in elderly patients and patients with diabetes, renal failure, or uncontrolled hypothyroidism.

Liver Dysfunction Cases of severe hepatic toxicity, including fulminant hepatic necrosis, have occurred in patients who have substituted sustained-release (modified-release, time-release) niacin products for immediate-release (crystalline) niacin at equivalent doses.

NIASPAN should be used with caution in patients who consume substantial quantities of alcohol and/or have a past history of liver disease. Active liver diseases or unexplained transaminase elevations are contraindications to the use of NIASPAN.

Niacin preparations have been associated with abnormal liver tests. In three placebo-controlled clinical trials involving titration to final daily NIASPAN doses ranging from 500 to 3000 mg, 245 patients received NIASPAN for a mean duration of 17 weeks. No patient with normal serum transaminase levels (ALT, AST) at baseline experienced elevations to more than 3 times the upper limit of normal (ULN) during treatment with NIASPAN. In these studies, fewer than 1% (2/245) of NIASPAN patients discontinued due to transaminase elevations greater than 2 times the ULN.

In three safety and efficacy studies with a combination tablet of NIASPAN and lovastatin involving titration to final daily doses (expressed as mg of niacin/ mg of lovastatin) 500 mg/10 mg to 2500 mg/40 mg, ten of 1028 patients (1.0%) experienced reversible elevations in AST/ALT to more than 3 times the ULN. Three of ten elevations occurred at doses outside the recommended dosing limit of 2000 mg/40 mg; no patient receiving 1000 mg/20 mg had 3-fold elevations in AST/ALT.

Niacin extended-release and simvastatin can cause abnormal liver tests. In a simvastatin-controlled, 24 week study with a fixed dose combination of NIASPAN and simvastatin in 641 patients, there were no persistent increases (more than 3x the ULN) in serum transaminases. In three placebo-controlled clinical studies of extended-release niacin there were no patients with normal serum transaminase levels at baseline who experienced elevations to more than 3x the ULN. Persistent increases (more than 3x the ULN) in serum transaminases have occurred in approximately 1% of patients who received simvastatin in clinical studies. When drug treatment was interrupted or discontinued in these patients, the transaminase levels usually fell slowly to pretreatment levels. The increases were not associated with jaundice or other clinical signs or symptoms. There was no evidence of hypersensitivity.

In the placebo-controlled clinical trials and the long-term extension study, elevations in transaminases did not appear to be related to treatment duration; elevations in AST levels did appear to be dose related. Transaminase elevations were reversible upon discontinuation of NIASPAN.

Liver function tests should be performed on all patients during therapy with NIASPAN. Serum transaminase levels, including AST and ALT (SGOT and SGPT), should be monitored before treatment begins, every 6 to 12 weeks for the first year, and periodically thereafter (e.g., at approximately 6-month intervals). Special attention should be paid to patients who develop elevated serum transaminase levels, and in these patients, measurements should be repeated promptly and then performed more frequently. If the transaminase levels show evidence of progression, particularly if they rise to 3 times ULN and are persistent, or if they are associated with symptoms of nausea, fever, and/or malaise, the drug should be discontinued.

Laboratory Abnormalities **Increase in Blood Glucose:** Niacin treatment can increase fasting blood glucose. Frequent monitoring of blood glucose should be performed to ascertain that the drug is producing no adverse effects. Diabetic patients may experience a dose-related increase in glucose tolerance. Diabetic or potentially diabetic patients should be observed closely during

treatment with NIASPAN, particularly during the first few months of use or dose adjustment; adjustment of diet and/or hypoglycemic therapy may be necessary.

Reduction in platelet count: NIASPAN has been associated with small but statistically significant dose-related reductions in platelet count (mean of -11% with 2000 mg). Caution should be observed when NIASPAN is administered concomitantly with anticoagulants; platelet counts should be monitored closely in such patients.

Increase in Prothrombin Time (PT): NIASPAN has been associated with small but statistically significant increases in prothrombin time (mean of approximately +4%); accordingly, patients undergoing surgery should be carefully evaluated. Caution should be observed when NIASPAN is administered concomitantly with anticoagulants; prothrombin time should be monitored closely in such patients.

Increase in Uric Acid: Elevated uric acid levels have occurred with niacin therapy, therefore use with caution in patients predisposed to gout.

Decrease in Phosphorus: In placebo-controlled trials, NIASPAN has been associated with small but statistically significant, dose-related reductions in phosphorus levels (mean of -13% with 2000 mg). Although these reductions were transient, phosphorus levels should be monitored periodically in patients at risk for hypophosphatemia.

ADVERSE REACTIONS Because clinical studies are conducted under widely varying conditions, adverse reaction rates observed in the clinical studies of a drug cannot be directly compared to rates in the clinical studies of another drug and may not reflect the rates observed in practice.

Clinical Studies Experience In the placebo-controlled clinical trials database of 402 patients (age range 21-75 years, 33% women, 89% Caucasians, 7% Blacks, 3% Hispanics, 1% Asians) with a median treatment duration of 16 weeks, 16% of patients on NIASPAN and 4% of patients on placebo discontinued due to adverse reactions. The most common adverse reactions in the group of patients treated with NIASPAN that led to treatment discontinuation and occurred at a rate greater than placebo were flushing (6% vs. 0%), rash (2% vs. 0%), diarrhea (2% vs. 0%), nausea (1% vs. 0%), and vomiting (1% vs. 0%). The most commonly reported adverse reactions (incidence >5% and greater than placebo) in the NIASPAN controlled clinical trial database of 402 patients were flushing, diarrhea, nausea, vomiting, increased cough and pruritus.

In the placebo-controlled clinical trials, flushing episodes (i.e., warmth, redness, itching and/or tingling) were the most common treatment-emergent adverse reactions (reported by as many as 88% of patients) for NIASPAN. Spontaneous reports suggest that flushing may also be accompanied by symptoms of dizziness, tachycardia, palpitations, shortness of breath, sweating, burning sensation/skin burning sensation, chills, and/or edema, which in rare cases may lead to syncope. In pivotal studies, 6% (14/245) of NIASPAN patients discontinued due to flushing. In comparisons of immediate-release (IR) niacin and NIASPAN, although the proportion of patients who flushed was similar, fewer flushing episodes were reported by patients who received NIASPAN. Following 4 weeks of maintenance therapy at daily doses of 1500 mg, the incidence of flushing over the 4-week period averaged 8.6 events per patient for IR niacin versus 1.9 following NIASPAN.

Other adverse reactions occurring in ≥5% of patients treated with NIASPAN and at an incidence greater than placebo are shown in Table 1 below.

Table 1. Treatment-Emergent Adverse Reactions by Dose Level in ≥ 5% of Patients and at an Incidence Greater than Placebo; Regardless of Causality Assessment in Placebo-Controlled Clinical Trials

	Placebo-Controlled Studies NIASPAN Treatment*				
	Placebo (n = 157) %	500 mg† (n = 87) %	1000 mg (n = 110) %	1500 mg (n = 136) %	2000 mg (n = 95) %
Gastrointestinal Disorders					
Diarrhea	13	7	10	10	14
Nausea	7	5	6	4	11
Vomiting	4	0	2	4	9
Respiratory					
Cough, increased	6	3	2	< 2	8
Skin and Subcutaneous Tissue Disorders					
Pruritus	2	8	0	3	0
Rash	0	5	5	5	0
Vascular Disorders					
Flushing‡	19	68	69	63	55

Note: Percentages are calculated from the total number of patients in each column.

* Adverse reactions are reported at the initial dose where they occur.

† Pooled results from placebo-controlled studies; for NIASPAN, n = 245 and median treatment duration = 16 weeks. Number of NIASPAN patients (n) are not additive across doses.

‡ The 500 mg/day dose is outside the recommended daily maintenance dosing range.

§ 10 patients discontinued before receiving 500 mg, therefore they were not included.

In general, the incidence of adverse events was higher in women compared to men.

Postmarketing Experience Because the below reactions are reported voluntarily from a population of uncertain size, it is generally not possible to reliably estimate their frequency or establish a causal relationship to drug exposure.

The following additional adverse reactions have been identified during post-approval use of NIASPAN:

Hypersensitivity reactions, including anaphylaxis, angioedema, urticaria, flushing, dyspnea, tongue edema, larynx edema, face edema, peripheral edema, laryngismus, and vesiculobullous rash; maculopapular rash; dry skin; tachycardia; palpitations; atrial fibrillation; other cardiac arrhythmias; syncope; hypotension; postural hypotension; blurred vision; macular edema; peptic ulcers; eruption; flatulence; hepatitis; jaundice; decreased glucose tolerance; gout; myalgia; myopathy; dizziness; insomnia; asthenia; nervousness; paresthesia; dyspnea; sweating; burning sensation/skin burning sensation; skin discoloration, and migraine.

Clinical Laboratory Abnormalities Chemistry: Elevations in serum transaminases [see Warnings and Precautions], LDH, fasting glucose, uric acid, total bilirubin, amylase and creatine kinase, and reduction in phosphorus.

Hematology: Slight reductions in platelet counts and prolongation in prothrombin time [see Warnings and Precautions].

DRUG INTERACTIONS **Statins** Caution should be used when prescribing niacin (≥1 gm/day) with statins as these drugs can increase risk of myopathy/rhabdomyolysis. Combination therapy with NIASPAN and lovastatin or NIASPAN and simvastatin should not exceed doses of 2000 mg NIASPAN and 40 mg lovastatin or simvastatin daily. [see Warnings and Precautions].

Bile Acid Sequestrants An *in vitro* study results suggest that the bile acid-binding resins have high niacin binding capacity. Therefore, 4 to 6 hours, or

as great an interval as possible, should elapse between the ingestion of bile acid-binding resins and the administration of NIASPAN.

Aspirin Concomitant aspirin may decrease the metabolic clearance of nicotinic acid. The clinical relevance of this finding is unclear.

Antihypertensive Therapy Niacin may potentiate the effects of ganglionic blocking agents and vasoactive drugs resulting in postural hypotension.

Other Vitamins or other nutritional supplements containing large doses of niacin or related compounds such as nicotinamide may potentiate the adverse effects of NIASPAN.

Laboratory Test Interactions Niacin may produce false elevations in some fluorometric determinations of plasma or urinary catecholamines. Niacin may also give false-positive reactions with cupric sulfate solution (Benedict's reagent) in urine glucose tests.

USE IN SPECIFIC POPULATIONS **Pregnancy** Pregnancy Category C. Animal reproduction studies have not been conducted with niacin or with NIASPAN. It is also not known whether niacin at doses typically used for lipid disorders can cause fetal harm when administered to pregnant women or whether it can affect reproductive capacity. If a woman receiving niacin for primary hyperlipidemia becomes pregnant, the drug should be discontinued. If a woman being treated with niacin for hypertriglyceridemia conceives, the benefits and risks of continued therapy should be assessed on an individual basis.

All statins are contraindicated in pregnant and nursing women. When NIASPAN is administered with a statin in a woman of childbearing potential, refer to the pregnancy category and product labeling for the statin.

Nursing Mothers Niacin is excreted into human milk but the actual infant dose or infant dose as a percent of the maternal dose is not known. Because of the potential for serious adverse reactions in nursing infants from lipid-altering doses of nicotinic acid, a decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the mother. No studies have been conducted with NIASPAN in nursing mothers.

Pediatric Use Safety and effectiveness of niacin therapy in pediatric patients (≤16 years) have not been established.

Geriatric Use Of 979 patients in clinical studies of NIASPAN, 21% of the patients were age 65 and over. No overall differences in safety and effectiveness were observed between these patients and younger patients, and other reported clinical experience has not identified differences in responses between the elderly and younger patients, but greater sensitivity of some older individuals cannot be ruled out.

Renal Impairment No studies have been performed in this population. NIASPAN should be used with caution in patients with renal impairment [see Warnings and Precautions].

Hepatic Impairment No studies have been performed in this population. NIASPAN should be used with caution in patients with a past history of liver disease and/or who consume substantial quantities of alcohol. Active liver disease, unexplained transaminase elevations and significant or unexplained hepatic dysfunction are contraindications to the use of NIASPAN [see Contraindications and Warnings and Precautions].

Gender Data from the clinical trials suggest that women have a greater hypotensive response than men at equivalent doses of NIASPAN.

OVERDOSAGE Supportive measures should be undertaken in the event of an overdose.

PATIENT COUNSELING INFORMATION **Patient Counseling** Patients should be advised to adhere to their National Cholesterol Education Program (NCEP) recommended diet, a regular exercise program, and periodic testing of a fasting lipid panel.

Patients should be advised to inform other healthcare professionals prescribing a new medication that they are taking NIASPAN.

The patient should be informed of the following:

Dosing Time NIASPAN tablets should be taken at bedtime, after a low-fat snack. Administration on an empty stomach is not recommended.

Tablet Integrity NIASPAN tablets should not be broken, crushed or chewed, but should be swallowed whole.

Dosing Interruption If dosing is interrupted for any length of time, their physician should be contacted prior to restarting therapy; re-titration is recommended.

Muscle Pain Notify their physician if any unexplained muscle pain, tenderness, or weakness promptly. They should discuss all medication, both prescription and over the counter, with their physician.

Flushing Flushing (warmth, redness, itching and/or tingling of the skin) is a common side effect of niacin therapy that may subside after several weeks of consistent NIASPAN use. Flushing may vary in severity and is more likely to occur with initiation of therapy, or during dose increases. By dosing at bedtime, flushing will most likely occur during sleep. However, if awakened by flushing at night, the patient should get up slowly, especially if feeling dizzy, feeling faint, or taking blood pressure medications. Advise patients of the symptoms of flushing and how they differ from the symptoms of a myocardial infarction.

Use of Aspirin Medication Taking aspirin (up to the recommended dose of 325 mg) approximately 30 minutes before dosing can minimize flushing.

Diet Avoid ingestion of alcohol, hot beverages and spicy foods around the time of taking NIASPAN to minimize flushing.

Supplements Notify their physician if they are taking vitamins or other nutritional supplements containing niacin or nicotinamide.

Dizziness Notify their physician if symptoms of dizziness occur.

Diabetics If diabetic, to notify their physician of changes in blood glucose.

Pregnancy Discuss future pregnancy plans with your patients, and discuss when to stop NIASPAN if they are trying to conceive. Patients should be advised that if they become pregnant, they should stop taking NIASPAN and call their healthcare professional.

Breastfeeding Women who are breastfeeding should be advised to not use NIASPAN. Patients, who have a lipid disorder and are breastfeeding, should be advised to discuss the options with their healthcare professional.

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Manufactured for Abbott Laboratories, North Chicago, IL 60064, U.S.A.

500 mg tablets

by Norwich Pharmaceuticals, Inc., Norwich, NY 13815

or

500 mg, 750 mg and 1000 mg tablets

by Abbott Pharmaceuticals PR Ltd., Barcelona, PR 00617

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303-525002 MASTER

Japan is the most earthquake-savvy nation in the world—yet it was defenseless against March's Sendai event, which killed thousands and wreaked havoc on infrastructure.

Can Science Make Us Safer?

> BY JEFF WISE

C

COULD A SENDAI-SIZE EARTHQUAKE HAPPEN HERE in the U.S.? Experts say it's not a matter of if, but of when. The areas most at risk are not, as you might expect, California's cities. While they frequently suffer damaging quakes, their seismic woes are due to a relatively shallow phenomenon called a strike-slip fault, caused by two tectonic plates grinding against each other.

The Sendai event, which struck Japan in March with a magnitude of 9.0, resulted from a far more dangerous "megathrust," or subduction fault, in which one plate slides underneath another. The contiguous U.S. hasn't experienced such an unleashing of geological violence since Jan. 26, 1700, when a subduction fault off the coast of the Pacific Northwest ruptured with a magnitude of 9.0, sending a 30-foot wall of water roaring across the ocean. Twelve hours later, it smashed buildings and killed people in coastal Japan, 4500 miles away.

In 1700, the Pacific Northwest was sparsely inhabited. Today, the combined population of Portland and Seattle is more than 1.1 million people, and based on geological evidence, there's a 10 to 15 percent chance another quake of that magnitude will strike those cit-

ies in the next 50 years. Other cities in quake-prone regions are also vulnerable, including such unlikely places as Memphis, Tenn., Charleston, S.C., and New York City. And California's San Andreas Fault, while not of the megathrust type, remains formidable. Running close to most of the state's big population centers, it has a history of producing a large quake roughly every 150 years. (The last one was 154 years ago.) In all, 75 million Americans live in areas where quakes could cause substantial damage.

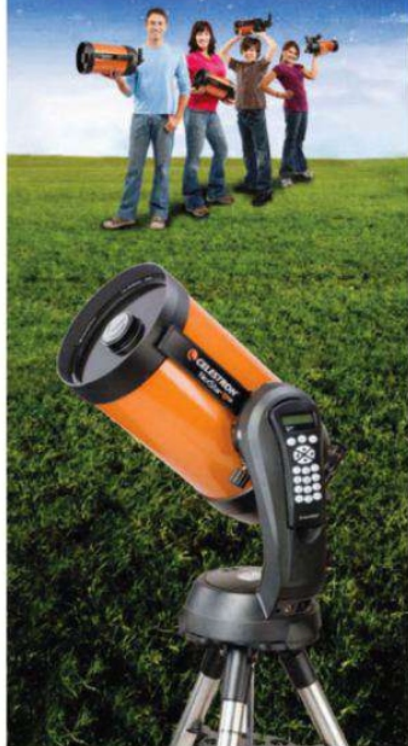
Despite decades of research, seismologists are still unable to predict these catastrophic events. Some experts fear they may be chaotic phenomena and hence fundamentally unpredictable. Instead, scientists focus on more attainable goals, deploying sensor arrays, satellite instrumentation and computer simulations to develop a clearer picture of how earthquakes happen, where they are likely to strike and how much damage they can do. "We're working on the basic physics," says Bill Ellsworth, a seismologist with the U.S. Geological Survey. "We need to answer these questions: How strong will the shaking be? Is there an upper limit? Those are critical in terms of designing structures that remain standing."

HALFWAY BETWEEN LOS ANGELES and San Francisco, a leveled patch of dirt on the shoulder of a grassy hill is ringed with a chain-link fence and

WITH JAPAN STILL REELING, U.S. SCIENTISTS STUDY QUAKE ZONES HERE TO HELP MINIMIZE POTENTIAL DAMAGE.

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P M

EARTHQUAKE TECH /// SCIENCE OF SAFETY

dotted with a few small buildings. Beneath one of them is something quite extraordinary: a peephole deep into one of the most active parts of the Earth's crust. A team led by Ellsworth spent four years drilling a 2-mile-deep, 8-inch-diameter well for a project called the San Andreas Fault Observatory at Depth, or SAFOD.

The borehole descends straight down, then curves eastward toward the shear zone between the Pacific and North America plates. The original borehole cut across the fault, but the movement of the plates—about an inch and a half per year, relative to each other—soon began severing it. Today, an instrument package that contains a seismometer, an accelerometer, a tiltmeter and other sensors rests in the shaft a short distance from the slippage. Ellsworth hopes SAFOD will operate for at least another decade, collecting fault-line data.

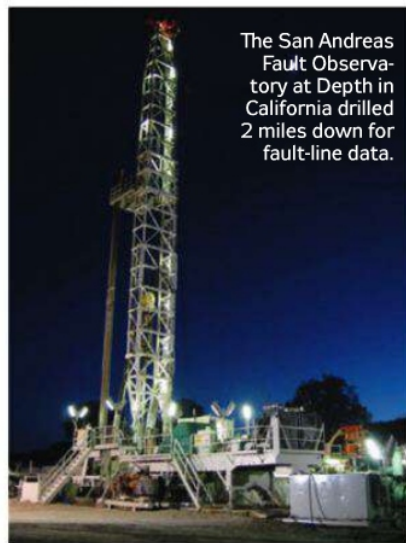
In a sister program, Ellsworth's colleagues are trying to deduce the behavior of the Earth's crust through precise measurements on the ground. The Plate Boundary Observatory consists of a network of ground sensors spread over thousands of miles along the Pacific Coast. Thanks to super-sensitive GPS technology, these sensors can collectively measure deformation of the landscape with millimeter accuracy. Some scientists believe that sudden deformations might offer an early quake warning.

Farther south stands another outpost of earthquake science: America's largest shake table, the Large High Performance Outdoor Shake Table (LHPOST) at the University of California, San Diego. On a recent sunny spring morning, a three-story masonry building atop the facility's 40-foot-long platform begins lurching violently from side to side. Within seconds, it starts to crumble. Bricks above a window spill down in sheets. Cracks spider-web out through the cinder block wall. It shatters and tumbles. By the time the movement stops 22 seconds later,

the ground is heaped with rubble.

It's been a bad day for this particular building but a jackpot for science. By testing the effects of shaking on full-scale structures, LHPOST provides engineers the real-world data they need to hone their computer models and figure out how to make buildings safer in the future.

In this case, the ruined structure was made of a reinforced concrete frame with walls of unreinforced masonry—a style that was popular in the 1920s and that can still be found throughout the California danger



The San Andreas Fault Observatory at Depth in California drilled 2 miles down for fault-line data.

zone. "Since many of these buildings have historic value, they can't just be torn down and replaced," says UCSD professor of structural engineering Benson Shing.

In the wake of the destructive test, Shing's team rebuilds the structure, then retrofits it with antiearthquake measures. On the ground floor, they spray the walls with a 1-inch layer of cement mixed with sand and glass fibers. On the second floor, they glue sheets of glass fiber-reinforced polymer onto the wall much as one would apply wallpaper. Once the shake table gets rocking, a few cracks appear, but the walls remain intact.

JAPAN IS THE MOST EARTHQUAKE-savvy nation on earth. Its population is psychologically prepared, its building codes are tough, and it lavishes millions of dollars on research. Its

E-Defense shake table, located at the Hyogo Earthquake Engineering Research Center, north of Kobe, is the world's largest, capable of holding full-scale buildings up to seven stories high and weighing up to 2.5 million pounds.

Japan has also spent decades implementing an Earthquake Early Warning (EEW) system that transmits an alarm signal to population centers. Because a quake's motion travels at the speed of sound and a fiberoptic signal can travel near the speed of light, such a system could provide anywhere from a few seconds to more than a minute of warning.

The EEW helped save the lives of more than 150 passengers aboard a bullet train in 2004, when a magnitude 6.8 quake struck the island of Honshu. The train was traveling at 125 mph about 11 miles from the epicenter. Within 3.6 seconds of the quake, an observatory detected the tremors. Simultaneously, an alarm issued and the train's power supply was cut. The operator applied the brakes, significantly reducing speed. Two and a half seconds later, violent tremors hit. The train derailed, but no one aboard was injured. A similar system gave Tokyo 80 seconds' warning of the Sendai quake.

The U.S. is just starting to explore these kinds of technologies. The USGS has begun to install 120 seismic monitors in the most vulnerable areas of California, mainly in the Los Angeles basin and the northern part of the state. Still, building the system will take time. "We're talking at least three years, and probably five" before it becomes operational, project chief David Oppenheimer says.

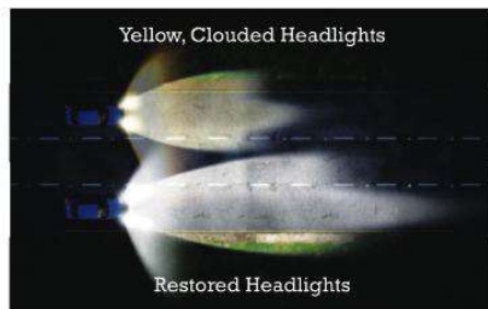
With public support, similar systems could be placed in every quake-prone part of the U.S.—even in places whose residents may not realize that slowly, invisibly, inexorably, the earth is moving beneath their feet.

PM



Meet the newest member of the Mothers® PowerBall® family, PowerBall 4Lights®.

Designed to quickly and safely restore, maintain and protect all types of plastic headlights to crystal clarity.



Not only is this an unsightly problem, but lower light output also reduces your ability to see at night, creating a serious safety concern.



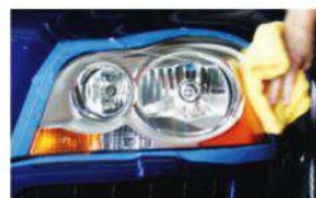
Sunlight, heat, cold, rain, smog, and harsh chemicals can accelerate the affects of oxidation, dulling and degrading headlights.



STEP 1: Prep. Works with any cordless drill. Apply a nickel-sized amount of PowerPlastic 4Lights® Polish.



STEP 2: Polish. With Mothers® PowerBall 4Lights®, headlight restoration is safe and easy.

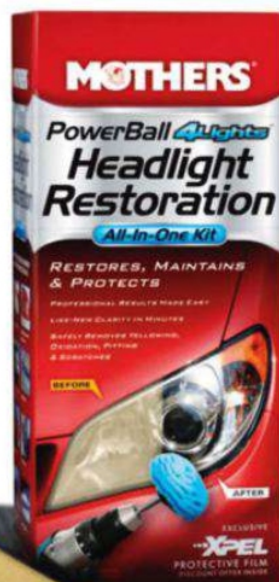


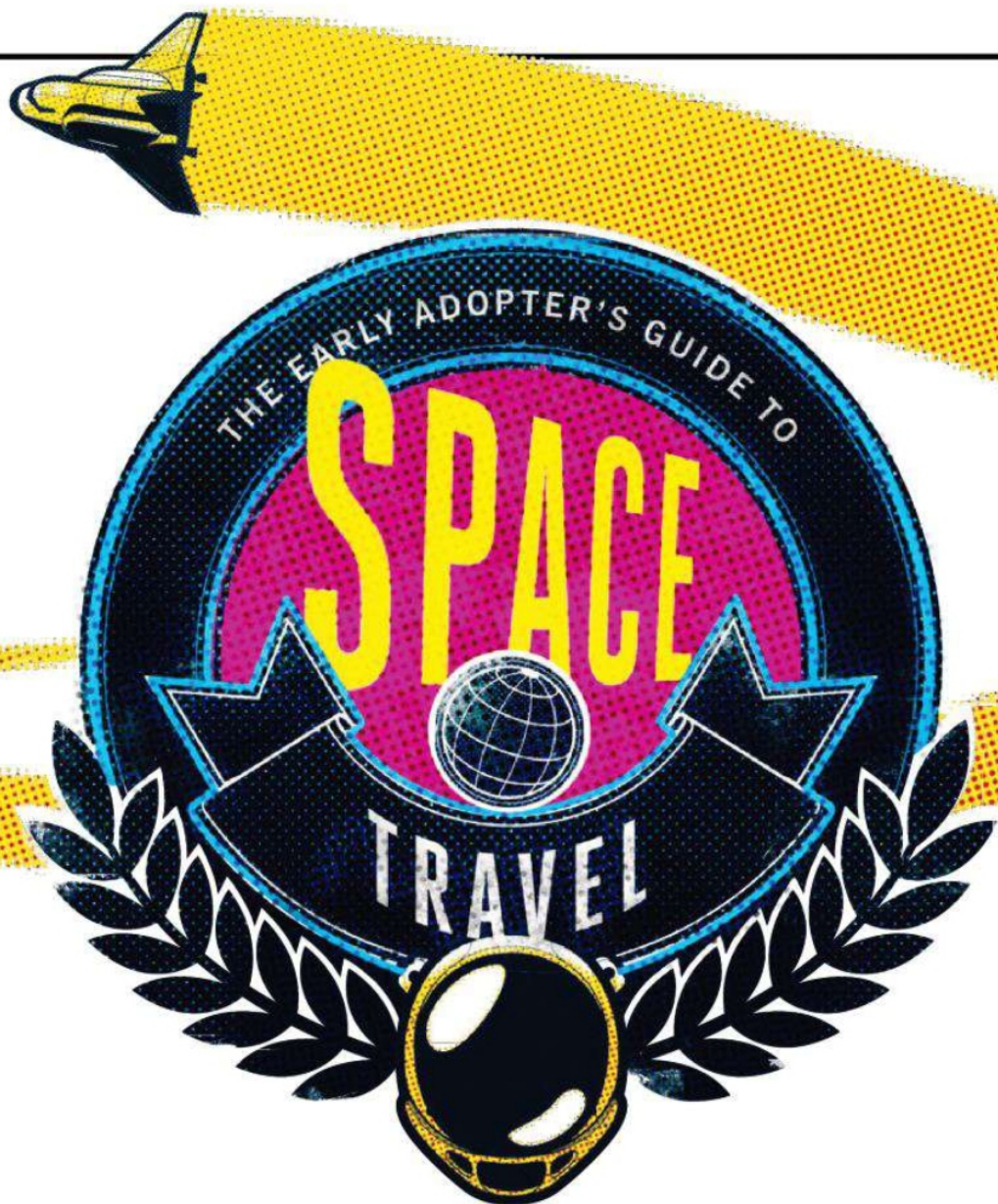
STEP 3: Shine. Buff clean with microfiber towel. Enjoy the crystal-clear results.



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Forget Italy or the Bahamas. Soon, you will have a more exotic stamp to add to your passport: outer space. So, how will you get there and what exactly will the trip be like? PM consulted the visionary engineers now building next-gen private spacecraft. Here, a sneak peek at humanity's ultimate tourist destination.

BY ERIK SOFGE

ILLUSTRATION BY GABRIEL SILVEIRA

2012

THERE ARE DOZENS OF MILES TO GO before you're an astronaut. But at an altitude of 50,000 feet, your spaceflight is under way. That's when WhiteKnightTwo, the plane that has been in control so far, releases your craft like a massive bomb, and it starts to free-fall. After a 3000-foot drop, SpaceShipTwo's rocket fires. The craft bucks. The thrust presses you deep into your seat, building as you climb. On paper, you're experiencing nearly 4 g's, equal to four times Earth's gravity. In practice, this gradual ramp-up to Mach 3 is smooth and exhilarating. The media might focus on the weightlessness you'll soon feel, but that's not the point. You don't spend up to six years on a Virgin Galactic waiting list, or longer than that, maybe an entire lifetime, dreaming of floating. The dream was always to land a seat on a rocket ship.

Not everyone shares this dream, or even respects it. Decades ago, the world watched in wonder as the first NASA astronauts escaped the atmosphere to circle the planet and later set boots on the moon. Today, being one of the first 100 customers to put down \$200,000 for a trip into space has earned you a place in Virgin Galactic's founders group. From the wider world, that honor has inspired a collective shrug. After all, starting with Dennis Tito's \$20 million ride aboard a Russian Soyuz in 2001, a handful of citizen astronauts flew earlier and higher. Tito and the six Space Adventures customers who followed him made it all the way to orbit, where they boarded the International Space Station. The craft that Virgin Galactic flies, SpaceShipTwo, barely kisses the void at a peak altitude of 68 miles, offering just 4 to 5 short minutes of weightlessness before gravity pulls it back into the atmosphere. It may be a giant leap for the leisure class, but for mankind's expansion into space, it's hard to imagine a smaller baby step.

Of course, no one signs up for the amenities: There are no flight attendants passing out champagne or directing your attention to the bathrooms. Rocket ships don't have flight attendants—or bathrooms. They have rockets, which are sinking those 4 g's straight into your chest as the blue sky outside your window drains to black. Part of you hopes the

ILLUSTRATOR ADAM NICKEL

ENVISIONS THE DAY PEOPLE

BOARD A SPACE PLANE FOR

THEIR NEXT VACATION.



ascent never ends—this amount of power seduces. In fact, many of Virgin Galactic's customers are pilots or "people who simply love flight," says CEO George Whitesides.

SpaceShipTwo is lean and efficient, more like an experimental aircraft than a commercial plane. A special mother ship hauls it into the sky, then hybrid rocket motors take over; the craft returns to the runway in a controlled glide. It is the direct descendant of SpaceShipOne, which took the \$10 million Ansari X Prize by making two suborbital flights within two weeks in 2004. Virgin Galactic partnered with the vehicle's developer, Scaled Composites, to create a followup to the winning design, and after years of development, SpaceShipTwo was unveiled in 2009. It's carried aloft by WhiteKnightTwo, and along with seats for a pilot and co-pilot, it has enough room for six passengers to briefly unbuckle and drift around the cabin.

Virgin Galactic isn't the only company with suborbital aspirations in 2012. XCOR Aerospace plans to undercut Virgin with \$95,000 flights on its two-person Lynx space plane; tickets for Armadillo Aerospace's vertical launching and landing rocket will start at \$100,000. According to Whitesides, Virgin Galactic is already looking past suborbital, throwing its support behind the development of orbit-class shuttles from both Sierra Nevada Space Systems and Orbital Sciences Corp.



Scaled Composites founder and 2006 PM Breakthrough Leadership Award winner Burt Rutan inside SpaceShipTwo. The craft had its first solo glide flight at California's Mojave Air and Space Port last October.



ALTHOUGH THE PRIVATE SPACE INDUSTRY IS GROWING, it's far from viable, or proven. That's where you come in. Someday they'll say that mass space travel started in 2012. Before it extended into orbit and beyond, the suborbital hops sustained a global industry. And you were there, as a deep-pocketed early adopter, a zero-gravity guinea pig, a philanthropist donating to a dream of private spaceflight that sounds

like science fiction and might never be profitable. Most of all, though, you were there as an astronaut—or a spaceflight participant, according to the Federal Aviation Administration (FAA)—on SpaceShipTwo.

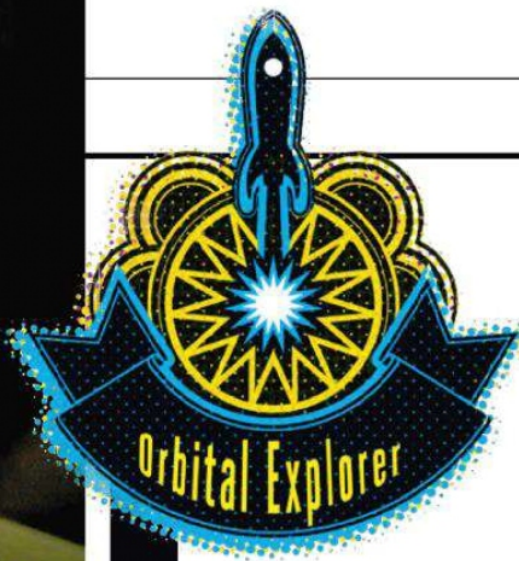
The transition to nearly zero g, or microgravity, happens quickly, and at an altitude of 62 miles, your float time is under way. Here's where your training matters. You've been in microgravity before, on multiple parabolic flights, where 727s perform an undulating series of swoops and soars, creating something like weightlessness for up to 30 seconds at a time. The sensation is sickening for a small percentage of people, but for most, it tends to focus all attention on the suddenly novel mechanics of motion in a gravity-free environment. When passengers aren't giggling, they're moving all wrong, trying to swim in midair or pushing too hard off walls and objects. It takes a little practice to turn the volume down, stop being amazed at this altered state and remember to look out the window.

The window is where you're headed. Not to take a picture—the craft is studded with cameras inside and out, to discourage participants from frittering away precious time squinting into their own point-and-shoots—but to see what's out there. You push off the seatback, keeping your legs and arms

tucked close. Everyone on board has some sort of plan, and they all start the same, with a drift toward one of the wide, circular windows scattered liberally throughout the craft. The 5-minute countdown is ticking away, and it's nonnegotiable. When SpaceShipTwo's arc turns into a fall, it falls hard, peaking at 6 g's. That's potential blackout territory, and serves as the craft's effective flight ceiling—any higher and passengers would stay weightless longer but face even more g-loading upon re-entry. You prepared for that too: During your three-day preflight training at New Mexico's Spaceport America, you practiced the breath-clenching tricks fighter pilots use to keep from blacking out during high-speed maneuvers. That's the part of the trip, the ride down, that will test your mettle.

The descent will come in a few minutes. Right now, you are 68 miles high. The Earth fills your view. It's all that matters.





2022

IT IS CALLED THE OVERVIEW effect. It's not a single epiphany, but rather a series of them, all triggered by the simple act of staring at the world from space. After a full week in orbit, it's been a while since your last big one. From an earthward window in the habitat, you watch a fire blooming somewhere in the Midwest, along the Michigan-Ohio border. That was an early realization—that something is always burning. And that you can always see it, even when the smoke from a single burning house rises in a column and spreads, pooling against the dome of the atmosphere to cover a whole state.

Earth-gazing is one of the few luxuries aboard a space station. Of the handful of cylindrical habitats docked together to form this orbital space station—each one launched individually by Bigelow Aerospace, inflated in

orbit and steered into place—none holds a floating spa. Even as more habitats are added, the station expanding like a massive balloon animal, most will hold sleeping quarters and laboratory space.

Maybe one day a hospitality firm will erect a true space hotel—little clusters of private rooms with body-length windows and gourmet cuisine that doesn't ooze out of pouches. But for you, it's back to the grind. After all, no one goes to space to look at Earth all day. Most people here are flown into space on their companies' dime—in your case, to create protein crystals that grow purer and larger in microgravity for more precise drug testing. For the foreseeable future, space will be a workplace.

You fought for your spot, but for most of the thousands willing to risk that climb aboard a three-stage, orbit-class spaceship, the costs are prohibitive. This has almost nothing to do with fuel—which can account for as little as 0.5 percent of an orbital flight's price tag—and a whole lot to do with disposable vehicles. Even the most cost-effective rockets, such as SpaceX's Falcon 9, are ditched midflight. "A 747 costs around a quarter-billion dollars," says SpaceX CEO Elon Musk. "It doesn't cost half a billion dollars to fly round trip. That's because you don't destroy them after one use." Musk estimates that true reusability—a double-stage rocket design, or boosters that could fly themselves home—would lower costs by a factor of more than 100. However, it would also be "one of the most difficult and important inventions that humanity will ever achieve," he says.

In 2022, rockets are cheaper but far from reusable. So, while suborbital travel has exploded over the past decade,

Spaceport America, 55 miles north of Las Cruces, N.M., will serve as the headquarters for Virgin Galactic. UP Aerospace, Lockheed Martin and Armadillo Aerospace also plan to launch suborbital flights there.



YOUR SPACESHIP IS (ALMOST) READY

SUBORBITAL



SPACESHIP TWO

Manufacturer: Scaled Composites ➔ **Size:** 60 feet long, 42-foot wingspan ➔ **Seats:** Two crew members, six passengers ➔ **Propulsion:** Carried to 50,000 feet by the WhiteKnightTwo plane, then propelled to a maximum altitude of 68 miles by a hybrid liquid/solid-fuel rocket. ➔ **Launch Plans:** Scheduled to begin flights by 2013 from Spaceport America in New Mexico.



LYNX

Manufacturer: XCOR Aerospace ➔ **Size:** 35 feet long, 24-foot wingspan ➔ **Seats:** One pilot, one passenger ➔ **Propulsion:** Lifted by four liquid-oxygen-and-kerosene rockets to just above 62 miles. Like SpaceShipTwo, Lynx returns to the runway in a controlled glide. ➔ **Launch Plans:** Flight testing begins in 2012 at the Mojave Air and Space Port in California.

ORBITAL



DREAM CHASER

Manufacturer: Sierra Nevada Space Systems ➔ **Size:** 45 feet long, 23.5-foot wingspan ➔ **Seats:** One to two pilots, five to six passengers ➔ **Propulsion:** Launches vertically on a multistage rocket, like the Atlas V, then hybrid rockets propel it; lands like shuttle. ➔ **Launch Plans:** SNSS hopes to fly NASA crews to the space station by 2014 and is exploring private flights.



DRAGON

Manufacturer: SpaceX ➔ **Size:** 14 feet long, 12-foot diameter ➔ **Seats:** One pilot, six passengers ➔ **Propulsion:** Launches on SpaceX's two-stage Falcon 9 rocket; splashes down in the ocean. ➔ **Launch Plans:** The unmanned, cargo-hauling version has left and re-entered the atmosphere; SpaceX will fly it at least 10 more times before taking on NASA passengers.

LUNAR FLYBY



SOYUZ TMA

Manufacturer: RSC Energia ➔ **Size:** 22.9 feet long, 8.9-foot diameter ➔ **Seats:** One pilot, two passengers ➔ **Propulsion:** Launches on the three-stage Soyuz FG rocket; additional propulsion is required to reach the moon. ➔ **Launch Plans:** Once a customer pays \$150 million for the trip, Space Adventures expects to have systems in place within three and a half years.



DRAGON

Manufacturer: SpaceX ➔ **Size:** 14 feet long, 12-foot diameter ➔ **Seats:** Three to four ➔ **Propulsion:** Launches on the Falcon Heavy rocket, which has triple the Falcon 9's maximum thrust and/or increased range. ➔ **Launch Plans:** SpaceX CEO Elon Musk says a lunar flyby would be feasible—once the Falcon Heavy is built—for \$150 to \$200 million.

with a few thousand flights per year and prices settling in the \$20,000 to \$30,000 range, the orbital market is dominated by research-minded corporate and government clients that are willing or able to pay many millions of dollars for a week

or two in space. Even the visitors who pay their own way aren't really tourists; they float through these same lab modules with their own for-profit research projects or experiments. "We know that anyone we're going to bring up, even

for a short flight, won't just want to float around and take pictures," says former astronaut Leroy Chiao, today an executive vice president at Excalibur Almaz, which has purchased Russian space station modules for potential deployment. "Pretty soon that gets old. The people doing this want to do something meaningful," Chiao says.

Your time in space is running out. Tomorrow—in 24 hours, that is, since here the sun rises every 90 minutes—you'll be leaving, heading home in a shuttle that's scheduled to arrive at the station any minute. It's the same kind you rode up in: a Dream Chaser, carrying six passengers, one pilot and all the research gear and resupply cargo that can fit in the hold. The trip home, you've heard, is smoother than many suborbital flights, since the craft angles gradually into a 1.6 g's re-entry rather than diving in a relatively steep decline. The hardest part of orbital travel, it's said, is orbiting, and all the strange forces this environment exerts on the human body.

The most obvious effects include fluids shifting, which raises blood pressure as well as pressure in the lungs, face and eyes. For some, sleep can be difficult. And for most, there is some level of motion sickness. Richard Garriott, a computer-game designer and the sixth civilian astronaut, says roughly 80 percent of people feel sick in orbit, and pilots and roller coaster enthusiasts don't get a pass. "There's no correlation we can find between motion sickness on Earth and motion sickness in microgravity," says Garriott, who is Space Adventures' largest shareholder. It was his trip to the ISS in 2008 that cleared astronauts who'd had laser eye surgery to go orbital. Until then, doctors had feared elevated pressure might temporarily distort their vision.

It was a physical ailment that helped secure your spot on the space station. There were plenty of other applicants at your pharmaceutical company, most of whom could conduct the same research. But you happen to have Type 1 diabetes. The opportunity to

collect data on microgravity insulin injections and the day-to-day fluctuations of your blood sugar tipped the scales. These are the early days of the orbital-data gold rush, when a single procedure or study is often valued in the millions. Each flight is a major investment, and companies like yours want to squeeze the most out of every trip.

More of those investments are inbound. An announcement over the PA system sends you back to the window. The sun is rising, again, and the Dream Chaser's white surface is almost too bright to look at. Its Falcon 9 booster is long gone, and the shuttle—a smaller-winged, sawed-off

cousin of NASA's—is slowly rotating into a docking position. Behind it, you see more fires on Earth's surface. This isn't the Midwest, though. It's the Amazon rain forest, which has been burning here and there since you first reached orbit. For decades, in fact, astronauts have watched that land smolder.

The orbital view is harsh and matter-of-fact. There is beauty below, but humans are everywhere, their cities and suburbs filling the most livable spaces, the indelible signs of industry stitched across the others. This is your final epiphany: It's not a big world at all. It's smaller than you can possibly describe.



XCOR Aerospace engineer Mark Street with a wind tunnel model of the Lynx space plane. The company also developed a liquid-oxygen/methane engine—tested at California's Mojave Air and Space Port (below)—for future NASA manned missions.



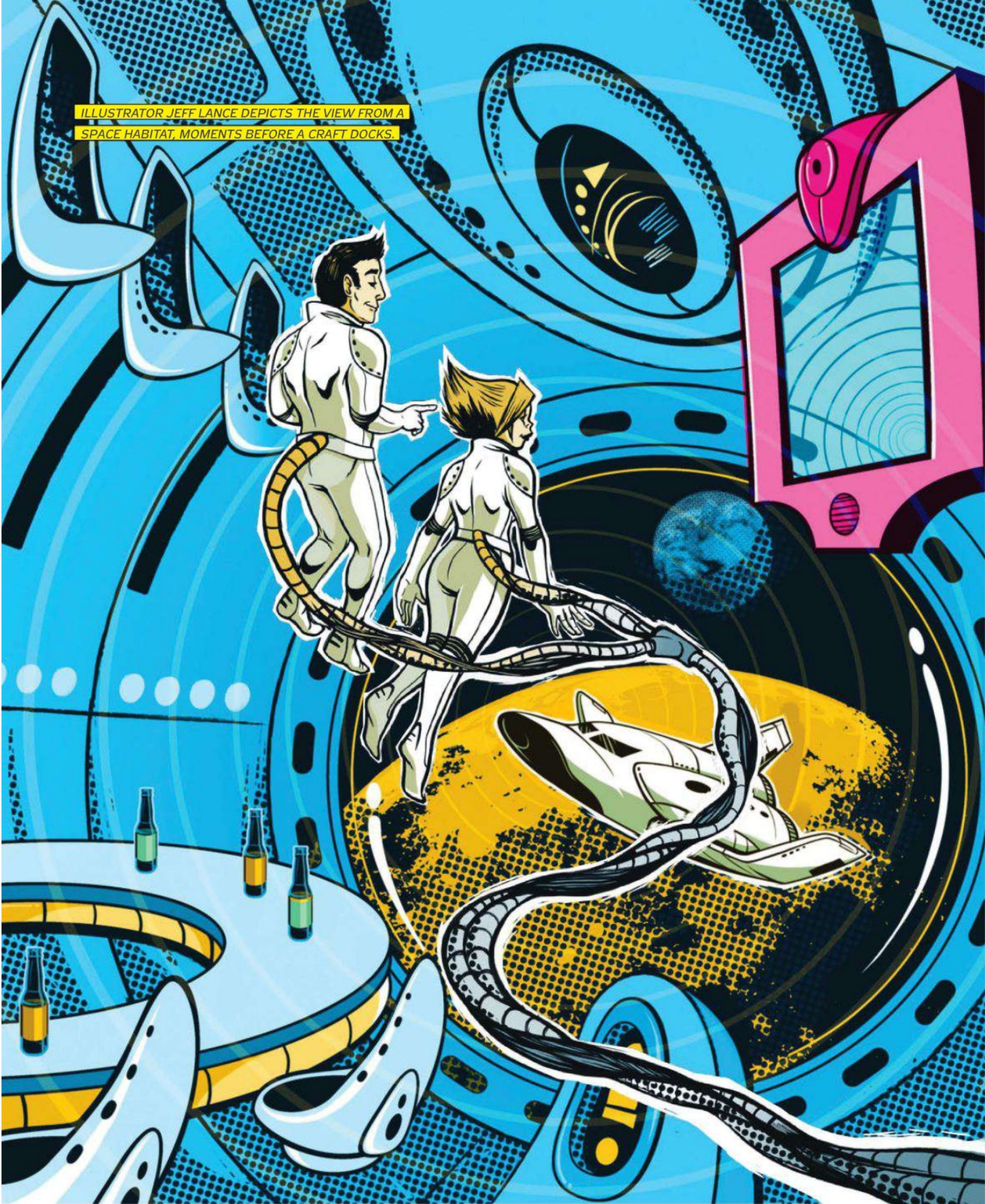
2042

IT'S NOT A TRAFFIC JAM, BUT THERE IS CONGESTION IN ORBIT. THE PILOT nudges your craft into a slow, slightly woozy spin as you stand by for clearance from the FAA. You don't mind the wait. You've never been on an old-fashioned rocket ship, with a massive liquid-fuel booster trailing the crew vehicle. There's a lot of potential energy sitting behind you—enough, it seems, to make it to the pocked, luminous rock now wheeling into view.

Ideally, there would be a countdown, an old NASA-style voice crackling



ILLUSTRATOR JEFF LANCE DEPICTS THE VIEW FROM A
SPACE HABITAT, MOMENTS BEFORE A CRAFT DOCKS.



T-minus updates over the radio. But compared to what Apollo astronauts experienced, your blastoff to the moon from 200 or so miles in orbit is a relatively casual affair. The pilot seated next to you in this well-appointed two-person shuttle confirms with traffic controllers that your flight path won't intersect with the orbit of the half-dozen habitats hurtling around the planet, and you almost hope he misses the launch window. If he did, you would spend an extra hour circling Earth, sitting in the cockpit of an almost comically small spaceship perched atop a mammoth booster vehicle at least 10 times its size. That would make this feel more like a mission and less like a joyride.

YOU WONDER WHETHER anyone is watching from one of the habitats or from Earth itself as the booster attached to the back of this shuttle fires. Probably not. Lunar flybys are almost universally ignored and generally considered a costly, pointless side trip for the idle rich, who have all but run out of adventures in space. Besides, privately funded rovers have been ambling through lunar craters for years, and a handful of civilians have already looped around the moon, back when that kind of a mission was, you know, hard.

Of course, nothing in space is actually easy. The shuttle you're in, which is similar to the Lynx suborbital space plane that used to fly four times daily or as often as 800 hops per year, is nothing like the cramped, no-frills Soyuz capsule that Space Adventures managed to swing around the moon many decades after Apollo. Instead of peeking through portholes, you have a panoramic view of the stars and the approaching lunar surface. An additional, miniature habitat module sits behind your shuttle so that you can spread out during the five-day trip. What makes this flight so expensive isn't the duration or the training required, which are almost identical to those of an orbital stay. It's the sheer energy needed to travel 240,000 miles and back, supplied by the booster mated to your craft.

This kind of ticket once cost as much as \$150 million, with spaceflight participants footing the bill for a colossal amount of gear to be hauled into space: a crew vehicle and

either a pair of rockets to take that craft orbital and then around the moon, or a single, larger rocket that could do both. In 2042, the price is in the low millions, thanks to a series of breakthroughs. The biggest of them was the strange rise of the beamship. This radical redesign of orbit-class spacecraft started small, with tiny, unmanned vehicles powered by ground-based microwave arrays. The beams would track a craft's hot-plate-like underside as it flew, heating and expanding the hydrogen onboard, producing more high-velocity thrust than traditional oxygen-and-hydrogen-burning rockets. The advantages of beam-powered flight are cumulative: Smaller, simpler, more stable craft would also be inherently lighter, and the heat exchanger that serves as a microwave target could act as a heat shield during re-entry.

"I know this sounds like science fiction the first time you hear about it, but when you look at the actual details, the numbers, it's not all that far-fetched," says Kevin Parkin, who heads Carnegie Mellon's Microwave Thermal Rocket project in collaboration with NASA.

Scaling up from robotic resupply missions to cheap, booster-free manned flights was inevitable, and brought the price of an orbital ticket down below \$100,000. In 2042, beamships regularly ferry cargo and passengers to orbit, while the purely chemical rockets and capsules are being retooled for manned missions to asteroids, Mars and other deep-space destinations. Every so often, a booster is tested by pushing a beamship around the moon—in this case, yours.

A couple of days into the flight, your lunar loop is nearing the halfway mark. Back in the cockpit, the pilot points out major features as you fly 62 miles above the moon's surface, but mostly this leg of the trip is quiet. You're



**INSTEAD OF PEEKING THROUGH PORTHOLE,
YOU HAVE A PANORAMIC VIEW OF THE STARS
AND THE APPROACHING LUNAR SURFACE.**

silent, watching craters flow by and imagining how long it will take, how many more flights like this, before boosters will be completely reusable, able to regularly land on that craggy, alien landscape, tank up with fuel harvested from automated lunar mines and lift off again. How long until the moon is teeming with life instead of dotted with roving machines. When, you wonder, will space really open up?

Then Earth rises from behind the moon, bright and bluer than any picture, any video or any description can capture, a glow that seems to spill into the cracked, lifeless lunar bowls and valleys below. It's as beautiful as those Apollo astronauts claimed, so pretty it's almost embarrassing.

Even so, your mind is already skipping ahead. Someone must be booking a flight around Mars. You should look into that.

PM

FIFTEEN WAYS THE INDIANAPOLIS 500 CHANGED THE WAY YOU DRIVE

BY EARL SWIFT

From the start, it was envisioned as part sporting event, part skunkworks: Indianapolis millionaire Carl Fisher sought to build a proving ground for new cars and ideas, where automotive reliability, speed and strength would be tested. A century later, the Indianapolis 500 has been true to Fisher's dream, and your everyday ride—from the drivetrain to the road and rubber on which it rolls—owes much to the race.

"It's made American cars perform a lot better," says Indy legend A.J. Foyt. "We put it way over the line at Indianapolis, so if it works there, it'll work on the highway."

"At Indy, we are the NASA of the production-car world, and that's clearly why manufacturers are involved—it's such a good testbed," says Mario Andretti, the 1969 winner.

Famed Indy driver and car builder Dan Gurney offers a different analogy. "Racing is like warfare," he says. "It accelerates the evolution of ideas."

Here's a look at some of the advances sparked by the battle in the Brickyard.



NEXT IN LINE
In a bid to increase fan appeal, officials will unveil two new Indycar designs at the 2011 race. One contender: this prototype—with a higher nose and airfoils spanning the front tires—by Swift Engineering of San Clemente, Calif.

REARVIEW MIRRORS

Driver Ray Harroun stirred controversy at 1911's inaugural 500 by entering the only single-seater in the field, a stinger-tailed Marmon Wasp. His fellow drivers, each of whom had a "mechanician" riding shotgun, knew that by motoring solo,

Harroun would have an edge in weight and aerodynamics. They complained that without a spotter beside him, Harroun would be blind to racers closing in from behind and thus be a danger to all. His solution: a rectangular mirror mounted to the cowl on four steel dowels. Harroun won the race, and by the mid-teens the

device—marketed as a "mirrorscope" or "cop-spotter"—was a popular aftermarket accessory. Incidentally, Harroun's mirror was a bust: It vibrated so fiercely during the race that he couldn't see a thing in it.

TWO // TIRE TECH

Early racers rode on tires of rubber and fabric, usually heavy cotton. If that sounds like a delicate arrangement, well, it was: The fabric made for weak sidewalls and also generated a lot of internal friction and thus heat; tire pressures could double in a couple of laps, and one turn too many could bring on a blowout.

That changed in the mid-teens, when tires with cords of twisted thread, not woven fabric, debuted at Indy. Formed by crisscrossing plies and sandwiched with rubber, the cords made for a looser but stronger weave and ran far cooler.

In 1925, Firestone introduced the balloon tire at Indy. It offered a wider

1

MARMON WASP 1911



LOOK BACK

Ray Harroun, who won the first Indy 500, mounted a rearview mirror on his car's cowl. He reportedly got the idea from one he saw on a horse-drawn vehicle.

PHOTOGRAPHS BY CORBIS/BETTMANN (MARION WASP), GETTY IMAGES (BLUE CROWN)

WHEELS RACETRACK TO ROADWAY



tread for better traction, as well as lower inflation pressure (30 psi versus the 50 psi common at the time), which smoothed the speedway's bumps, improving stability and handling. Indy lap times dropped, and "softer" tires quickly made their way into the consumer auto market.

"Racing had always been the test laboratory, because the demands of the track were far more extreme than anything on the street," says Al Speyer, executive director of Firestone Racing. "Indy was always the cornerstone."

The wide, low-profile tires found on many sports cars today originated at Indy in the 1960s, when Goodyear and Firestone had mobile labs at the race. Average lap speeds rose by 15 to 20 mph that decade, so tiremakers sought a new product with greater lateral muscle in the turns. That yielded shorter, stronger sidewalls and a wider footprint, attributes also adopted in consumer tires. Even now, Indy tire research influences rubber on the road as companies seek tread compounds that boost traction, resist wear and fight the heat buildup that Speyer calls "the enemy."

THREE // MAGNESIUM WHEELS

Racer and engineer Ted Halibrand spent World War II working with Douglas Aircraft. When the shooting stopped, he put his expertise to use in auto racing, crafting the first of what would become his trademark magnesium-alloy wheels. The 500's winner rode on Halibrands in 1946 and every year thereafter through 1963. Usually alloyed with aluminum and zinc, the wheels eventually made the jump to hot rods and muscle cars—and into motorhead vernacular as "mags." The low-profile rims found on many sports cars today can be traced to the original Halibrands.

FOUR // LIGHTWEIGHT ENGINE PARTS

Having quit his namesake car firm, Louis Chevrolet founded the Frontenac Motor Co., which never offered a viable production car, but developed a string of wildly successful Indy racers with "Fronty" aluminum crankcases and other hardware. A ground-up

Frontenac design won the 1921 race, and in 1923, driver L.L. Corum finished fifth in a Model T—a Model T!—equipped with a lightweight Fronty cylinder head. Chevrolet and engineer C.W. Van Ranst also used a lot of aluminum in engines Frontenac built for commercial clients such as Stutz. By the mid-'30s, hot rodders were routinely modding their engines with aluminum parts. Indy thus hosted early efforts to increase speed by trimming vehicle weight, and helped invent the high-performance auto aftermarket.

FIVE // FRONT-WHEEL DRIVE

After winning at Indy in 1922, driver Jimmy Murphy placed an order for a front-wheel-drive car, figuring he'd post better times if he were pulled, rather than pushed, through the turns. Legendary engineer Harry Miller, whose cars and engines won the 500 a dozen times, responded with a design that enjoyed success at Indy for years. A transverse-mounted transmission eliminated a driveshaft and heavy rear differential, lopping as much as 150 pounds from the car's weight. It also enabled the driver to sit on the floor pan, lowering the center of gravity. Murphy died in a wreck in 1924, before driving the car, but Dave Lewis piloted the Miller to second place at Indy in 1925, prompting other teams and automakers to adopt the configuration. In 1929, two American passenger cars—the

FRONT-WHEEL DRIVE 1947

ROOKIE MISTAKE

Front-wheel-drive Blue Crown Specials dominated the 1947 race. In his first Indy showing, Bill Holland led until he waved teammate Mauri Rose past, believing Rose trailed by a lap. Rose won; Holland took second.



The front tires steered and propelled the car, which was a problem as cars got faster.

The lack of a driveshaft simplified the powertrain, decreasing weight.

With a lower driver's seat, the cowl height and overall profile also dropped, reducing drag.

A smaller, simpler rear axle made room for a larger fuel tank.

St. Louis—built Ruxton and the Cord L-29—went into limited production with front-wheel drive. In the 80-odd years since, it has come to dominate the world's passenger cars.

SIX // SUPERCHARGERS AND TURBOCHARGERS

Supercharger technology predates the automobile by more than a generation (it evolved from blowers used to stoke blast furnaces), but it didn't catch on with auto enthusiasts until Mercedes sent a team of supercharged cars to Indy in 1923. The German cars were also rans, but the underlying idea—that pumping air into an engine's intake manifold boosts power—inspired Fred Duesenberg to develop a centrifugal supercharger for the 1924 race. A blown Duesey won that year, and the devices moved quickly into the mainstream. By the time superchargers were offered on the iconic Cord 812, in 1937, Indy race teams had honed the devices considerably.

Meanwhile, a variation on the technology was found in ships, airplanes and locomotives: turbochargers that pumped air into the combustion chamber like superchargers but were powered by

exhaust gases, not the crankshaft. The technology debuted at Indy in the Cummins Diesel Special of 1952, a crazy-fast car that was both made and undone by its turbo: The low-hanging air intake sucked up tire debris and clogged during the race, causing the engine to overheat. Later race teams "improved them a lot," legendary car builder A.J. Watson says. Detroit pursued turbos with surprising speed, offering the first production turbocharged gas engines in the 1962 Olds Cutlass Jetfire and Chevy Corvair Monza Spyder.

SEVEN // INTERCOOLERS

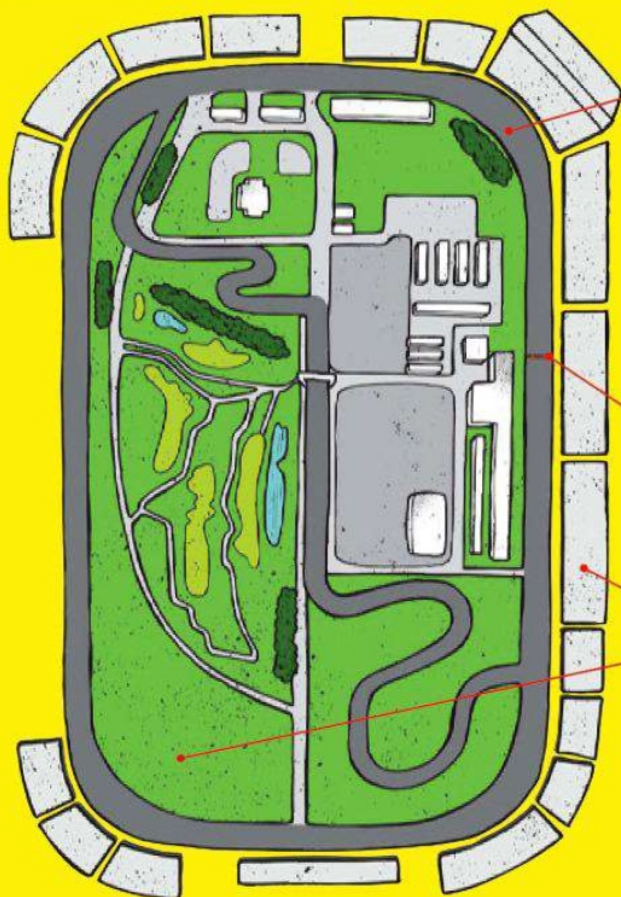
By the mid-'20s, race engineers recognized that superchargers were vexed by an unwanted byproduct, one that they would share with turbos: Air warmed as it was compressed and shoved into the intake manifold, and in the process lost density—thus compromising the very point of having a blower. The solution was a heat exchanger bolted between the charger and the engine. The first, in 1926 or 1927, was reputedly the brainchild of Frank Lockhart, an engineer and driver in Harry Miller's shop. The idea didn't take to the street until the '70s, when Porsche's early Turbo Carreras were augmented by intercoolers. Today, they're commonly found on supercharged and turbocharged passenger cars.

ALTERNATIVE FUELS

Indy teams studied alternatives to gasoline long before any inkling of an energy crisis. Driver Leon Duray experimented with methanol in Indy racers in or about 1927, midway through a career that saw him win the 500 pole twice and start six of his eight races in the top five. A methanol-fueled Miller set the longest-standing (for nine years) Indy lap record of 124.02 mph in 1928. In 1965, a year after gasoline increased the severity of a fiery seven-car Indy crash, the racers switched—permanently—to less volatile alcohol fuels.



THE BRICKYARD BY THE NUMBERS



Entering Turn One after the **3330-FOOT FRONTSTRETCH**, cars are generally running at **225 MPH**, but the drivers keep the gas pedal floored. **TIRE SCRUB REDUCES SPEED TO A STILL-INSANE 220 MPH.**

A driver running flat out sustains **MORE THAN 3 G'S** in all the turns. So a 160-pound driver presses against the side of the cockpit with **480 POUNDS OF FORCE.**

Because Indycars rev up to **16,000 RPM**, they provide a brutal test for consumer engine oils. "If you can make an engine lubricant that lives through [Indy], it's going to do well in production cars," Mario Andretti tells PM.

In the fall of 1909, **3.2 MILLION BRICKS** were used to resurface the track, giving the venue its nickname, the Brickyard—and making the race much safer. Except for the start/finish line, the track was paved with asphalt in 1961.

Known as the Yard of Bricks, the start/finish line is **3 FEET WIDE** and made of original 1909 Indy bricks.

The first Indy 500 winner, Ray Harroun, earned **\$14,250**. In 2010, winner Dario Franchitti pocketed **\$2.75 MILLION**. (The 2011 prize had not been announced by press time.)

Of the approximately **400,000 SPECTATORS**, **257,000 FILL THE GRANDSTAND** and other permanent seats, and the remainder watch from the **253-ACRE** infield.

It takes a lot of food and drink to feed all those people. The official consumption totals in 2009 included **30,000 GALLONS OF BEER AND SODA**, **10,000 POUNDS OF BRICKYARD BURGERS** and **8 MILES OF HOT DOGS AND BRATWURST.**

NINE // ELEVATED CURVES

In 1911, when most roads were built for horse traffic, Indy became perhaps the first American motorway with banked curves. Averaging 9 degrees, 12 minutes, they helped early racers achieve high speeds—and may have encouraged highway engineers. When a panel of them designed the Lincoln Highway's "Ideal Section" in the early 1920s, it decreed that curves be likewise banked and have a minimum radius of 1000 feet—safe for cars going 35 mph. As Indycars became faster in the 1930s, a string of deadly wrecks led officials to widen the Brickyard's curves and redesign their retaining walls to return errant cars to the track. In 1955, similar thinking spawned a standard of the modern American highway: the Jersey barrier.

TEN // SEATBELTS

Many early fatalities occurred when drivers were ejected from vehicles, but it wasn't until 1922 that Barney Oldfield ordered a harness for his Indycar from a parachute manufacturer—and reputedly became the first driver to buy seatbelts. (Oldfield, also the first to achieve a mile a minute on an oval track, and inspiration for

BARNEY OLDFIELD 1922



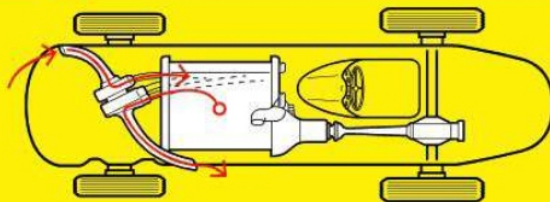
the traffic-cop inquiry—"Who do you think you are, Barney Oldfield?"—had evidently grown cautious; he didn't race at Indy in 1922 but rather drove the pace car.) Automakers caught the safety bug much later. Nash offered factory-installed seatbelts in 1949, and the Big Four made front-seat belts standard in 1964.

ELEVEN // FOUR-WHEEL DISC BRAKES

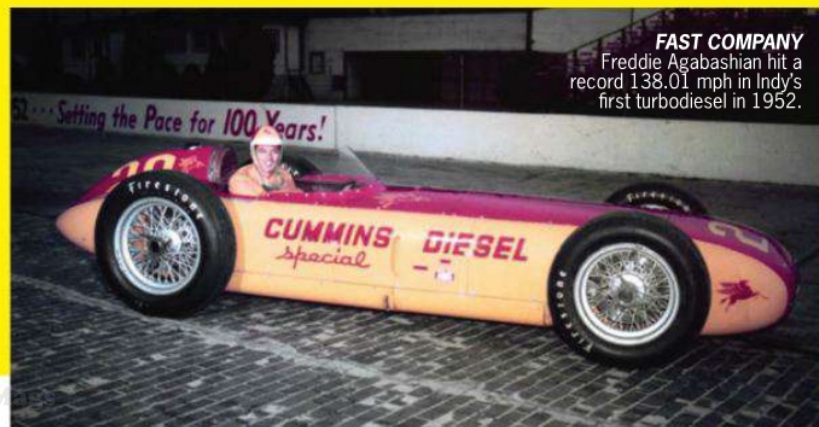
Another gift from racing genius Harry Miller, four-wheel disc brakes first appeared on his four-wheel-drive Miller Specials of the late '30s. The midengine cars weren't very fast, but they sure could stop. Discs caught on among other teams in the late '40s. They were first offered to American motorists on Crosley's tiny passenger cars of 1949. "The race created the disc brake, 100 percent," says Mario Andretti, who ran the 500 29 times and won it in 1969.

TURBOCHARGED DIESEL 1952

A unique car hit the bricks at Indy in 1952. Powered by a massive turbodiesel engine, it set speed records but failed when track debris clogged the turbocharger.



HEAVY BREATHING Through a port by the right front wheel, the turbocharger sucks in air, blows it into the engine—increasing horsepower—and then exhausts the spent fuel through pipes on the car's left side.



FAST COMPANY
Freddie Agabashian hit a record 138.01 mph in Indy's first turbodiesel in 1952.



LAST LOOK

In a monocoque-body car at Indy in 1964, Eddie Sachs crashed and died in the second lap. The wreck, which also killed driver Dave MacDonald, involved seven cars and was the first ever to stop the race.

UNIBODY CONSTRUCTION 1960s

Introduced to Indy in the 1960s, the monocoque tub was an early type of unibody construction. The breakthrough, paired with a rear-engine setup, cut weight and upped average lap speeds by more than 15 mph.



STEEL-TUBE FRAME

This typical roadster skeleton survived even after rear engines debuted in the 1960s.



MONOCOQUE TUB

Sheet metal was riveted together, forming a stiff structure that doubled as frame and body.



12 // HIGH-PERFORMANCE DIESELS

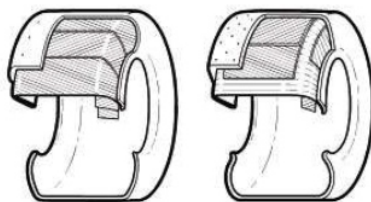
Diesels were known for brute strength, long life and black smoke, but hardly for speed, when Clessie L. Cummins convinced speedway officials to let him enter the race with an experimental car in 1931. Dropped into a custom Duesenberg chassis, the four-cylinder Cummins didn't break any records, but it ran the entire race without a pitstop and took 13th—and did it five years before Mercedes marketed the first diesel passenger car. Cummins steadily improved his diesels and had a breakthrough for the 1952 race, when he commissioned car builder Frank Kurtis to craft a low, sleek chassis around a 6.6-liter turbocharged truck motor laid on its side. Driver Freddie Agabashian shocked the racing world by riding the

Cummins Diesel Special to the pole. Mercedes and Peugeot began offering the first turbodiesels to the masses in 1978.

THIRTEEN // HARD DRIVING SURFACES

Indy offered an early and painful demonstration of the fact that roads built for horses would not meet the demands of fast-spinning rubber tires. The track's original surface was a variation on bituminous macadam: gray gravel laid atop a clay base and covered in a thick slathering of pitch, which itself was layered under 2 inches of finer gravel and pitch and then covered with white stone. The track's designer promised that once smoothed by steamroller, this concoction would be harder, safer and faster than other American courses. But the surface came undone in the opening minutes of the speedway's August 1909 inaugural weekend. As Charles Leerhsen writes in his entertaining new book, *Blood and Smoke: A True Tale of Mystery, Mayhem and the Birth of the Indy 500* (Simon & Schuster, 2011), track debris "could rip a man's face to bloody ribbons, crack or work its way around the edges of his goggles, and invade his eyes, blinding him to slow-moving or broken-down vehicles ahead." Deep ruts led to rollovers. Five people died: a driver, two riding mechanics and two spectators. In the fall of 1909, Fisher and his partners rebuilt the Indy track with 3.2 million bricks. The Brickyard was born. That same year, 92 percent of America's 2.2 million miles of public roads were dirt; concrete pavement accounted for 9 miles. Today, our paved roads span 2.7 million miles; the interstate system alone required nearly 300 million cubic yards of concrete.

TIRE SWITCH 1978



BIAS-PLY

The cords run at alternating crisscross angles, increasing internal heat and making for stiffer sidewalls, which distort the tire's footprint in turns.

RADIAL

Rayon, Kevlar and steel cords are set perpendicular to the centerline. This reduces heat buildup, allowing for higher-traction rubber compounds.



FOURTEEN // FOUR-WHEEL DRIVE

This now-common consumer-car setup saw an early application at the speedway. In 1934, a 4WD Harry Miller car led the race for several laps. In the late '30s, Miller designed another line of 4WD racers, the Gulf Specials, which attracted a lot of ink but proved no more sure-footed than racers with two-wheel drives—and slower than many of them. That didn't stop others from championing the form: In 1946, a twin-engine Fageol managed plenty of speed before it ran into a wall, and in 1963, Andy Granatelli entered an all-wheel-drive car with Bobby Unser at the wheel, to middling effect.

AERODYNAMICS

Indy cars have been platforms for streamlining theory since the first race: Ray Harroun's 1911 Marmon Wasp was so named because its tail tapered to a point, an early (and farsighted) stab at trimming drag.

In the early '70s, when most American cars were aerodynamic battering rams, Indy teams borrowed from aviation to boost speeds and trim fuel consumption, deploying inverted wings and ground-effects skirts on race cars. The whale's tails and spoilers in vogue among modern tuners can trace their lineage to Indy teams' efforts to increase downforce and cheat the breeze.

In 1971, driving legend and team owner Dan Gurney added a thin bracket of sheet metal to the trailing edge of his Indy car's rear wing—and was shocked to find that it dramatically boosted the car's traction and speed in the turns.

Today, a variation on the Gurney flap can be found on a slew of modern passenger cars from BMWs to Toyotas: It's the little lip at the trailing edge of the trunklid. Never mind that rear-end downforce isn't critical on either a luxury ride or a front-drive econobox. "Whether it's there as a styling item or it really works," Gurney says, "well, that's the way the industry goes." **PM**

HALL CHAPARRAL 1978

With a suite of aerodynamic features, the Chaparral 2K debuted in 1979 and won six times in 27 Indy series starts in just three seasons. Johnny Rutherford drove a 2K to victory in the 1980 Indy 500.



FRONT WING

Essentially an upside-down airplane wing, this feature creates downforce to increase front-tire traction.

AIR INTAKE

This duct feeds cool air to the sidepod-mounted radiators.

GROUND EFFECTS

Two channels beneath the car create a vacuum that literally sucks the car downward.

REAR WING

Like all aerodynamic devices, it produces downforce and drag, which engineers balance for traction and streamlining.

SURGEON GENERAL WARNING:
Cigar Smoking Can Cause Lung
Cancer And Heart Disease.



INTRODUCING MACANUDO CRÜ ROYALE

The Macanudo legend continues: This medium-bodied cigar has the unmistakable quality and consistency you expect from Macanudo, with a deeply decadent taste and clean finish. Available at fine retailers nationwide.

MACANUDO
ONE  ALL

Northeast of Anchorage, Alaska, bush pilot Terry Holliday soars through a gorge on the Knik River, en route to the Knik Glacier, the kind of backcountry flying that's high in reward—and risk.



A photograph of a red and white De Havilland Otter floatplane on a lake. The plane is positioned in the lower left quadrant of the frame, facing towards the right. It has the registration 'N8691D' visible on its side. The lake is a murky, greyish-green color with several white ice floes scattered across its surface. In the background, a steep, rocky shoreline rises from the water's edge. The sky is not visible, as the top of the frame is filled with the dark, textured rock of the cliff.

LAST OF THE FRONTIER FLIERS

Vast wilderness, fickle weather, moose-hunter stalls—flying in Alaska has always been risky, and it's made even more so by the daredevil creed of the bush pilot. Now, a new generation of back-country aviators looks to technology to make northern skies safer.

BY JEFF WISE

PHOTOGRAPHS BY
JULIAN DUFORT

ON THE AFTERNOON OF Aug. 9, 2010, eight passengers climbed into a single-engine De Havilland Otter floatplane at a fishing lodge near Dillingham, Alaska. A light rain was falling from the low-hung clouds, and gusty winds roiled the surface of the lake, but the group was keen to press on to the next destination, a fishing camp on the Nushagak River. The poor weather had delayed them all morning, but now, finally, the pilot was giving them the thumbs-up.

They had every reason to trust his judgment. Theron "Terry" Smith, 62, was a former chief pilot for Alaska Airlines and one of the most experienced aviators in the state. By 2:30 pm, the last of the party was buckled in. With a full-throttle roar, the Otter rose from the lake and headed southeast.

It didn't get far. Three hours later, another pilot spotted the Otter's broken fuselage on a ridge a few miles from the lodge. A helicopter rescue party found four badly injured and five dead, including Smith.

Fatal airplane crashes are far from unusual in the far north, but the Aug. 9 accident was special. Among the dead was Alaska's former U.S. senator Ted Stevens, 86, one of the nation's leading advocates for aviation safety. A pilot himself, he had lured millions of dollars in federal aviation grants to the state.

That even a figure such as Stevens could wind up dead in a plane crash underscores the brutal reality of flying in Alaska, where the fatalities per capita are 20 times higher than the national rate. Alaskans have long accepted that risk. They have no choice: Aviation is essential to life in America's biggest state. It's how remote, roadless villages get their mail and supplies. It's how hunters and prospectors get into the backcountry. It's how fishing lodges bring in their clientele. Without small airplanes, modern life would be impossible across much of the state.

The huge distances and the rugged terrain are only part of what make Alaskan flying so dangerous. A National Transportation Safety Board (NTSB) study also identified what it termed bush syndrome, or the willingness of pilots to take risks that put themselves and their passengers in danger.

One example: a type of accident the NTSB categorizes as "visual flight rules (VFR) into instrument meteorological conditions (IMC)," meaning that a pilot who has been navigating by sight finds himself in weather conditions that make it impossible to see where he's going or which way is up. VFR into IMC is a leading cause of fatal crashes in Alaska, perhaps including the one that killed Stevens. The NTSB study noted that 50 percent of the pilots interviewed admitted to flying VFR into IMC, and nearly one-quarter of them did it intentionally.

Ted Stevens wanted to change that cavalier mindset. He helped to establish the Medallion Foundation, an educational nonprofit that encourages pilots and air carriers to promote a culture of safety. And he backed a Federal Aviation Administration-led technology initiative called Capstone. Under the program, which began in 1999, the government paid for private aircraft to be fitted with a GPS system that broadcasts the aircraft's position to ground-based transceivers, which then send back data about weather and the location of nearby aircraft. In regions where Automatic Dependent Surveillance-Broadcast (ADS-B) was implemented,



Fifty years of hunting trophies hang from the walls of Terry Holliday's hangar at the airport in Birchwood, Alaska. "I took most of the Alaskan ones by flying to where I was hunting," the bush pilot says. "The oldest one up there is a black bear from 1961."

the system cut accidents nearly in half.

But for all the talk of improving safety statistics through education and technology, it's important to recognize that there is a reason why some risk-taking bush pilots fly the way they do. In a decade of visiting Alaska, I've traveled frequently in small planes, occasionally in conditions that seemed insanely hazardous. Stevens's death made me think of all the times I'd flown low through mountainous terrain, or in disturbingly poor visibility.

I thought in particular of John Graybill, a renowned bush pilot whom I'd



Ted Stevens, a U.S. senator from Alaska for four decades (left), survived a 1978 plane crash at the Anchorage International Airport that killed his first wife, Ann. A longtime champion of aviation safety, he died last August with four others in a small-plane crash.

On the general aviation ramp at the Anchorage airport, which is now named for Stevens, Wilfrid Ryan Jr. (below left), owner of Ryan Air, and his son Lee prepare for takeoff in a CASA 212-200. The Ryans' 13-craft fleet services an area the size of the eastern U.S.



meter was off the charts was, I think, the same thing that kept Terry Smith in the air—and, to a certain extent, me.

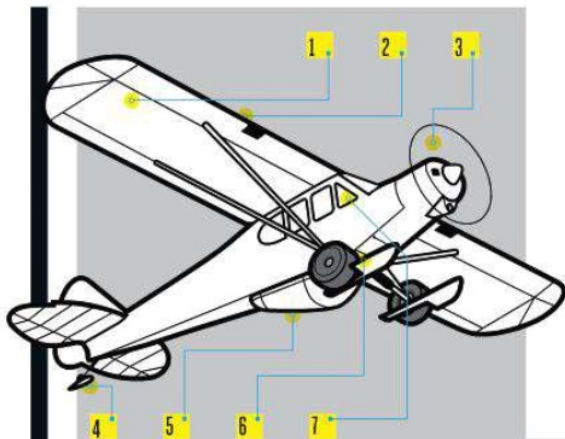
Riding shotgun with Graybill did not just give me premonitions of my own death. It also made me feel intensely alive. When I came back from my week with him, I felt oddly transformed. I began to have vivid dreams of flying small airplanes. In time, I became convinced that the only way to stop having these dreams was to get my pilot's license. And so, when a small wind-fall brought me a modest chunk of change, I drove to the nearest small airport and signed up for an introductory lesson. It was absolutely terrifying. Six months later, I had my ticket.

When I heard about Ted Stevens's death, I wanted to ask Graybill for his take so I could post it on my blog,

jeffwise.net. But I was in northern Manitoba at the time, and I had to check out of my hotel in 45 minutes. So I patched together a post based on past interviews, put it online and caught a ride to the airport.

I got home late, crawled into bed and woke up the next morning to find the following comment on my blog: "I thought that I would let you know that John Graybill died in a plane crash with

CONTINUED ON PAGE 150



THE PERFECT BUSH PLANE

Nearly 20 years after Piper Aircraft discontinued production of the PA-18, the Super Cub remains the iconic plane for the Alaskan outback. It's not the fastest bird in the sky, but the following features and modifications make it a great fit for even the roughest improvised runway. — DAVIN COBURN

profiled in 2001. As he squirmed me around the state in his two-seat plane, touching down on rough gravel bars and tundra-covered hilltops, Graybill seemed utterly fearless, even when high winds and turbulence shook us like a dog toy. He delighted in talking about the five crashes he'd survived. "You're not a bush pilot," he'd say, "until you've crashed a plane or two."

Graybill's behavior may seem baffling, but it was not wholly irrational. What kept him flying when the danger

1 HIGH WINGS
Increase visibility and allow for landings on strips with overgrown vegetation.

2 VORTEX GENERATORS
Metal fins atop the wing and under the horizontal stabilizer improve control.

3 CLIMB PROPELLER
Blades with a lower pitch angle boost takeoff and climb performance.

4 TAIL WHEEL
This configuration is more rugged than a tricycle-gear design and offers greater prop clearance.

5 BELLY TANK
This 32-gallon reservoir supplements two standard 18-gallon wing tanks.

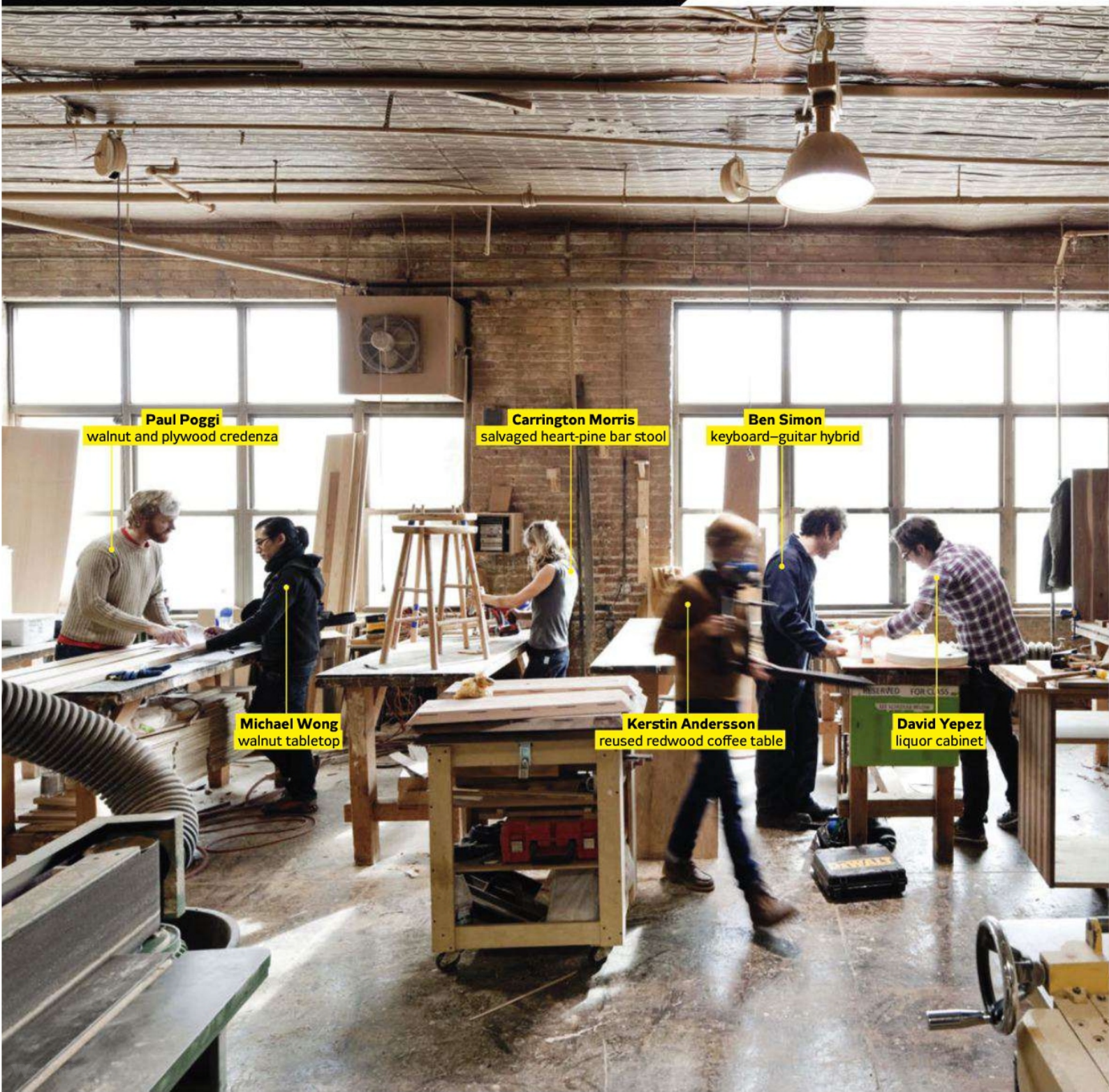
6 LANDING GEAR
Bush planes can be fitted with floats, tundra tires, skis or wheel-ski combos (shown here).

7 SAFETY AVIONICS
Garmin's GMX 200 provides GPS data and navigation aids, Iridium sat phones work even in remote villages, and emergency locator transmitters pinpoint downed planes.

DIV

UNDERGROUND

By Allen St. John



Paul Poggi
walnut and plywood credenza

Carrington Morris
salvaged heart-pine bar stool

Ben Simon
keyboard-guitar hybrid

Michael Wong
walnut tabletop

Kerstin Andersson
reused redwood coffee table

David Yeppez
liquor cabinet

IN HIDDEN SHOPS, GARAGES AND CONVERTED FACTORIES ACROSS AMERICA, NEW-SCHOOL COMMUNITIES OF CRAFTSMEN ARE SHARING SKILLS, PASSION—AND, YES, TOOLS—WITH PROS AND NEWCOMERS ALIKE. WELCOME TO THE LOYAL BROTHERHOOD OF THE BOLT. NOW GET TO WORK.

Photograph by Dean Kaufman

Illustrations by John Etheridge

Guitar Fanatics

{Burlington, Vt.}

Next-gen luthiers tackle everything from mandolins to electric 12-strings.



Creston Lea was building cabinets and playing music on the side when a friend asked him to install pickups on a guitar—Lea was the only guy he knew with a router. “I was terrified. A guitar seemed too precious,” Lea says. He did it—and then built a guitar body. Then another. Eventually, he had enough clients to quit his day job.

Now Lea is a member of an eclectic community of stringed-instrument builders in northern Vermont, who range from ex-Phish sound engineer Paul Languedoc to mandolin-maker Joseph Campanella Cleary and violin builder Warren Ellison.

Michael Millard, who creates heirloom-quality acoustic guitars for Froggy Bottom in nearby Chelsea, asked Lea for an electric guitar, Millard’s first. For the neck, Lea says, Millard specified $\frac{805}{1000}$ of an inch at the nut and $\frac{910}{1000}$ at the 12th fret. “I’d never had someone give me measurements in thousandths before,” Lea says.

Warehouse Woodworkers

{Brooklyn, N.Y.}

A hive of chisel-slinging dovetail enthusiasts crafts furniture in a reborn industrial space.

It all started with a tight spot crying out for a credenza. Pete Raho needed furniture that would fit into his tiny Brooklyn apartment, and when he couldn’t find anything at Ikea, he realized he needed to make it himself. Except that he didn’t have tools. Or a shop. Or woodworking skills.

Raho found all three at Makeville Studio, a Gowanus shop where he honed his craftsmanship capabilities. After finishing the credenza, Raho began working with a teacher from Williamsburg’s 3rd Ward, a cluster of warehouses and fabrication shops with a curriculum full of technical classes. The instructor, David Yepez, founded the furniture company David Alexander Designs. Raho and Yepez clicked. The teacher suggested that Raho tweak a new bike-rack design by replacing a simple butt joint with a more sophisticated spline, and Raho, an MBA, helped Yepez convert his back-of-the-envelope business plan to a more evolved cash-flow system. “I’m not a master craftsman and I’ll never be one,” Raho says of his furniture-making. “What I bring to it is a clever design that solves a problem a lot of people have.”

The 3rd Ward is just part of a burgeoning furniture scene in Brooklyn. Pros like Jonah Zuckerman design and build stunning dining tables, Nate Shellkopf uses reclaimed longleaf yellow pine to reproduce historic brownstone doors, and the retailer Tools for Working Wood has any marking gauge or bow saw a craftsman could need. The work finds an audience at annual events such as BKLYN Designs and at the weekly Brooklyn Flea, a DIY bonanza that serves as many new builders’ debut marketplace. Some of those rookies are one-time office workers who changed careers during the recession. “I could try to find another 9-to-5 job,” says Raho. “But it would be much more fun to be covered in sawdust every day.”

■ In a class at Brooklyn’s 3rd Ward shop, woodworkers shape heart pine into bar stools, and one student, Ben Simon, rewires a mid-1980s Casio synthesizer and clads it in mahogany.

Airheads Rally

Sturgis, Miss.

APRIL 15–17



The vintage BMW motorcycle nation (aka Airheads, named for their air-cooled engines) joins Craig “Vech” Vechorik at the Bench Mark Works open house and swap meet each spring. Vech, who says he has “twisted wrenches for a living” for 40 years, has tips—and parts—to offer riders rehabbing rare rides. Bring on the Slash-5 toaster tanks.

Follow Workshop Etiquette

RULE NO. 1

Don’t lend tools unless you can part with them for a while. Surfboard maker Timmy Patterson recently received a Skil 100 power planer someone had borrowed from his dad—40 years before.

RULE NO. 2

Don’t offer advice unless asked for it.

RULE NO. 3

No one likes your music.

RULE NO. 4

“Safety” is a six-letter word but a seven-day-a-week job. The Flaming Lotus Girls can train any builder on all tools—forklifts, torches—and their safety record is flawless. (They have fire extinguishers aplenty.)

RULE NO. 5

If a colleague does set himself on fire, put him out, whether or not he deserves it.

RULE NO. 6

Limit the personal information. You’re in the shop. Talk shop.

RULE NO. 7

Bring Pedro’s Tacos for the Surf Ghetto board shapers, bring pizza for the Dixie Bottleheads, and when in doubt, just bring beer.

Amp-Makers

{Asheville, N.C.}

The Dixie Bottleheads salvage retro tech for crisp audio.



"It's a rebellion against the idea that you can't design a piece of gear unless you have an engineering degree," amp builder Jim Dowdy says. Dowdy is a member of a loose group of perfectionist audiophile tube-amp builders called the Dixie Bottleheads, a crew that designs and builds components around vintage vacuum tubes. The Bottleheads use tubes not only for their lush, resonant tone, but also because they're rewarding to work with—small changes can yield big sonic benefits. Builders hunt for rarities, plundering midcentury war-surplus electronics for a windfall of otherwise-unobtainable vintage tubes.

To measure the changes wrought by a new transformer, the Bottleheads use a fail-proof test: listening. "A particular amp might have gone through eight iterations, so we just get a dozen people together and decide which is better," Dowdy says. "You have to listen with an open mind. And open ears."

Instructor Greg Bauer (no cap) teaches Gene Shaw (far right) and Dan Justis to craft a 20-foot catboat day sailer in Brooklin, Maine, a center for wooden boatbuilding.



Talk Shop Like a Pro

SPEAK PLANER

In the world of woodwork, do not mix up the terms "plane"—the hand tool—and "planer," the lumber-milling machine.

COLLET WHAT IT IS

A drill holds bits in a chuck, a router grips bits in a collet, and a circular saw blade spins on an arbor.

ARTICULATE A CAR

Pronounce "Porsche" as a two-syllable word. Do not say "Alfa Romeo" as if the name precedes "Juliet," and ask Q for the Aston—not Austin—Martin.

KNOW THE NAILS

To toe-nail, drive a fastener at an angle into perpendicular 2 x 4s. Face-nail a floor by hammering into the top side. Do not finger-nail.

JUST SAY "FUEL"

When in doubt, avoid terms like gasoline, diesel, nitro, propane, ethanol, acetylene, butane, methyl alcohol, kerosene or oil. Call it fuel, fool.

Boatmen

{Brooklin, Maine}

An armada of shops and craftsmen have made this hamlet into a national capital of wooden boats.

"There are eight boat shops in a one-horse town," sailboat builder and Brooklin, Maine, resident Brion Rieff says. The town thrives today, but the future was uncertain in 1978, when Steven White began working at the Brooklin Boat Yard, a business once funded by his grandfather, author E.B. White. At the time, low-maintenance fiberglass models seemed poised to send the wooden boat the way of the buggy whip.

Then advances in laminated woods and marine epoxies ushered in an era of cold-molded, low-maintenance wooden boats like the ones White builds in his 50-man shop. The WoodenBoat School, founded by *WoodenBoat* magazine publisher Jon Wilson in an attempt to preserve the craftsmanship of a dying art, soon began to flourish. Students today learn bronze casting and basic seamanship, and core courses teach novices to build their first boat. "Wood is alive," Rieff says. "And it smells good. You lay up a fiberglass boat and you stink." Or, as White puts it: "There's just something romantic about being up to your ankles in cedar shavings."

Kites Rise

Port Townsend, Wash.
MARCH 15–18, 2012



On a peninsula at the edge of Puget Sound, the Fort Worden Kitemakers Conference cranks out hundreds of kites, from paper and bamboo diamonds to 5 x 14-foot cells that take days to complete. "From 7 am to as late as you can stay up, there's someone there to talk kite-building," American Kitefliers Association president Barbara Meyer says.

PHOTOGRAPHS BY MICHAEL HEENEY (GUITAR, PREVIOUS SPREAD), PAUL JEREMIAS (AMPS), DARIN BACK (BIKE FRAMERS)





🔧 A Speedhound frame built by Peacock Groove gets the once-over from Speedhound designer Chris Cleveland (left) and Chris Kvale—frame builder, neighbor and member of the Minneapolis bike-building community.



Custom-Bike Framers

{Minneapolis}

Fix-a-flat pragmatism meets two-wheel fantasy.

vibrant bike scene thrives in Minneapolis, fueled by 130 miles of paths. Frame fabricator and Peacock Groove owner Erik Noren makes TIG-welded steel frames while hosting three additional builders in his shop: Matt Appleman builds carbon-fiber racing bikes, Vincent Dominguez does brazed frames, and Chris Cleveland constructs Speedhound bikes with a Swiss Army Knife vibe. The fringy Black Label Bike Club (named for the classic blue-collar beer) welds gravity-defying double-high bikes of pure antiestablishment bravado. They share winter biking tips at the Hub Bike Co-op, which hosts classes. “We fix bikes, and we encourage people to fix their own bikes,” says Benjamin Tsai, co-founder of the co-op. “We like to empower people.” In 2010, Noren organized Minnecycle, an exhibit of the work of eight local shops. “I did it to tell the stories behind the bikes,” Noren says. “I wanted people to know we’re laborers. We make things.”

Hot Rodders

{Montville and Pomona, N.J.}

Street freaks unite in custom-car clubs across the Garden State.



Two car clubs thrive at opposite ends of New Jersey. Co-founder Rich Conklin’s Dead Mans Curve Car Club is near New York, while Jim Rawa’s Street Aces club is 120 miles to the south. They have their differences: Conklin’s group hews to the Ed “Big Daddy” Roth street freak aesthetic—it favors 1960s drag racers re-tamed for street driving. Rawa, who at age 32 has owned 246 cars, leads young mechanics through pre-1964 “kustom” restorations. But the clubs share a DIY ethic. “Street Aces is not a buy-and-drive club,” says co-founder Rawa. “Just the opposite.” And to extend the spindles on a ’55 Chevy, the 55-year-old Conklin once scavenged steel from a bucket loader on his pumpkin farm.

The clubs mingle at Lead East, a Jersey car show in its 29th year. Conklin and Rawa met there when Rawa was just 13, talking shop about a rehabbed ’71 Chevelle—that belonged to his mom.

Gourds Soar

Bridgeville, Del.

NOVEMBER 4–6



More than 20,000 people on nearly 100 teams gather the week after Halloween to launch forlorn pumpkins as far as homemade cannons and catapults can fling ‘em. Wolfman Joe Thomas’s winning 2009 shot flew more than 3000 feet into the wind—if that’s too daunting a distance, just gussy up and go for the Miss Punkin Chunkin Pageant prize.



Robots Stroll

Dallas MAY 14 AND NOVEMBER 12

Robot building is a competitive endeavor by nature—any designer wants his bot to complete a task the most quickly and efficiently. Texas’s biannual RoboRama event puts machines through formal contests like the RoboColumbus way-finding challenge. The appeal, Tankbot co-builder Paul Bouchier says, is “to see something you made work under its own power.”



Flaming Lotus Girl Rebecca "Hotmetal" Anders uses an oxyacetylene cutting torch to alter the roots of *Mutopia*—a fire-breathing metal robot flower.

PHOTOGRAPH BY JOHN DEVENEZIA

W

Fireball Sculptors

{San Francisco}

The Flaming Lotus Girls shape metal and tame propane to make fire art.

While she was working on her first fire sculpture, Pouneh Mortazavi dragged pieces of iron pipe to Home Depot every night, where she'd sort through plumbing bins to find a length that fit. "Then I figured out that there were numbers on the pipes," she says. "I was pretty proud of that." She's come a long way—Mortazavi is one of the first members of the Flaming Lotus Girls, a group that designs and builds outrageous fire sculptures. Its first project was a flower-shaped kerosene shooter adorned with pink glitter. *Soma*, a recent creation, takes the shape of a massive neuron, with 36 computer-controlled, audience-actuated fire features.

The group's projects require skill in MIG welding, sheet-metal fabrication, wiring for LED lighting, plumbing for the propane, and computer programming to control it all. Their grand ambitions, coupled with a limited budget, demand collaboration. "It's a do-ocracy," member Caroline Miller says. "You don't ask to be a Flaming Lotus Girl, you just show up and work. If you're there when a decision needs to be made, you make it."

Flabobians Fly
Riverside, Calif.
MAY 20–22



Ohio-made 1930s and '40s Aeronca airplanes are so well-suited to DIY restoration that Flabobians—members of the local Experimental Aircraft Association club—helped a group of area teenagers rebuild an Aeronca 65-CA and gave them flying lessons. See the teens' work, and about 25 other Chiefs and Champs, at Flabob Airport's Aeronca Fly-In.



Soapboxes Roll
Akron, Ohio JULY 23

After dominating their hometown downhill derbies across the globe, over 500 racers in homemade street missiles converge on Akron for the world championship: the All-American Soap Box Derby. At the 74th annual contest, racers will top speeds of 30 mph in their quest for the Scarlet Jacket.



Surfboard Maestros

{San Clemente, Calif.}

Shapers work magic in a world-famous surf center.

Calle de Los Molinos, a historic strip in San Clemente, Calif., known to locals as the Surf Ghetto, is one of the birthplaces of the modern surfboard. Along this row of storefronts and shops, legends rub elbows with rookies.

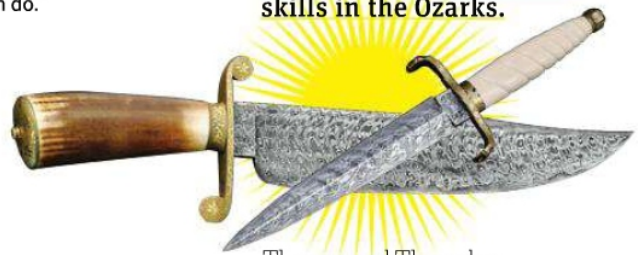
"The 30 guys in this area build as good a board as anybody in the world," Lost Surfboards co-founder Matt Biolos says. Among them is third-generation shaper Timmy Patterson. "He's the best," says Biolos, whose shop shares a wall with Patterson's. The local board culture thrives in part thanks to its proximity to one of the world's great surf spots—Lower Trestles—home to consistent waves and two international contests every year. It's a perfect test lab for a new design, and Patterson is happy to tinker. "I get the same feeling I got when I was a kid," Patterson says. "Make something with your hands, in your garage, and then you get to ride your own product. That's the stoke of it."

■ "It's the hot-rod building mentality," surfboard shaper Timmy Patterson says. "It's something the average guy can do."

Dagger Types

{De Queen, Ark.}

Blade-maker crew Al's Pals sharpens members' skills in the Ozarks.



The second Thursday of every month, the Riverside Machine Shop in De Queen, Ark., becomes the center of the knife-making universe as six of the world's greatest blade-smiths and 40 aspiring knife-makers gather to learn the secrets of the craft. The informal group—known as Al's Pals in honor of host and Riverside owner Al Lawrence—watch, for example, a Damascus steel blade and the antlers of a sambar stag become a hand-forged bowie knife. Rookies begin with queries on temperature control, then move on to strategies for refining the grain structure of carbon steel.

"At first they're intimidated to ask a question, but then they realize I'm just another guy," master bladesmith J.R. Cook says. "You progress much faster by having someone as a sounding board. You can read stuff, but until you see it firsthand, you don't understand it fully." **PM**

Launch a DIY Scene

LOCATE AN EXPERT

Every DIY culture has its guru, a guy who knows every trick in the book and loves nothing more than to share his hard-won wisdom.

LURE BEGINNERS

Diversity is key to a successful group. Newbies ask the kind of, um, uninformed questions that often end up educating everyone in the basics.

FIND A SPACE

What's a club without a clubhouse? Finding a space where you can leave your in-progress project until next week is the difference between a bunch of buddies playing with power tools and a real DIY collective.

SET A GOAL

Nothing gets the juices flowing like a deadline. Whether it's the entry cutoff for the local hot-rod show or a client clamoring for a completed product, external pressure is a prime motivator.

Stars Shine

Valentine, Neb.

JULY 31–AUGUST 5



About 175 telescopes—many of which are handcrafted Newtonian-style tools on Dobsonian mounts—gather for stargazing in one of the darkest spots in America. "The homemade scopes' plywood and low-cost materials provide very functional telescopes that probably would not win any beauty contests," the Prairie Astronomy Club's Bob Kacvinsky says.

250-CC BIKES

GETTING STARTED

By Ben Stewart
Photographs by Sasha Eisenman



The thought of swinging a leg over a motorcycle for the first time is both daunting and thrilling. After all, motorcycles are serious machines. And—without proper training or safety gear—dangerous ones. But once you’ve taken a training course and earned the privilege to ride, a new world opens up. Even the most boring superslab commute can become a brain-engaging experience when the wind is in your face and your body is wrapped around a pulsating lump of internal combustion. And because just about every motorcycle is a fuel-economy champ, riding a bike makes financial sense.

The smartest new riders enroll in the Motorcycle Safety Foundation (MSF) RiderCourse (msf-usa.org). “People who have never touched a motorcycle have the basic skills by the end of the weekend,” says Tim Buche, president of MSF. “Our course helps them to make good decisions on the street. And it’s better that they learn in a controlled environment where they can make mistakes without life-threatening consequences.”

With the RiderCourse under your belt, it’s time to invest in some gear. The Motorcycle Industry Council (MIC) recommends that riders wear a DOT-approved helmet every time they ride. The folks at MIC (and the folks at PM) recommend always wearing a real motorcycle jacket, gloves, eye protection, over-the-ankle boots and sturdy

MODERN 250-CC BIKES AREN'T JUST FOR NEWBIES;
THEY'RE INEXPENSIVE TO OWN, THEY RETURN
HYBRID-HUMBLING FUEL ECONOMY, AND, YEAH,
THEY'RE FUN TOO.

A high-action photograph of a motorcycle rider in a black leather suit and helmet, riding a motorcycle with a bright, glowing headlight. The rider is in the foreground, and another rider is visible in the background. The scene is set in a dusty, open environment with a warm, golden light.

Want in on
the action?
Start with a
lightweight,
250-cc motorcycle.
Here, we test
six of the best:

Hyosung GT250

Kawasaki

Ninja 250R

Honda CBR250R

Kawasaki
KLX250SF

Yamaha
V Star 250

Suzuki GZ250

HYOSUNG GT250

KAWASAKI NINJA 250R



STATS

PRICE: **\$3699**
 POWERTRAIN:
249-cc liquid-cooled V-twin/5M
 WHEELBASE (in.): **56.5**
 SEAT HEIGHT (in.): **32.7**
 WEIGHT (pounds): **375**
 SUSPENSION TRAVEL, F/R (in.): **5.6/5.8**
 BRAKES F/R: **11.81-in. disc/9.05-in. disc**
 TIRES F/R: **110/70-17/150/70-17**
 0-60 MPH (sec): **8.64**
 40-70 MPH (sec): **8.94**
 QUARTER-MILE (sec/mph): **16.58 @ 75.6**
 60-0 BRAKING (ft): **138**
 PM FUEL ECONOMY (mpg): **60.2**

!
NATURAL HABITAT

It needs a fairing for long-distance work, but it's game for anything else.

In this group of tiny two-wheelers, the Hyosung is a giant. Unlike many other 250-cc bikes, which are built on shrunken frames to fit smaller engines, the GT250 uses the same chassis as a full-size GT650. It's like a Korean version of a Ducati Monster, but includes some rough spots. The front brake feel is mushy, and it takes a fistful of lever to slow down the bike. And while the fuel-injected twin does pack reasonably good punch and sounds throaty, the engine's vibration buzzes the handlebars. Moderate speeds on twisty roads are comfortable, but the suspension wallows slightly when pushed. "The handling was quite vague throughout the Glendora Mountains," PM contributor Basem Wasef says. Hyosung says it'll fix the problem for 2011 models with a new rear shock. Even with its shortcomings, at \$3699, the GT250 is one of the best bargains of the group.



STATS

PRICE: **\$3999**
 POWERTRAIN:
249-cc liquid-cooled parallel twin/6M
 WHEELBASE (in.): **55.1**
 SEAT HEIGHT (in.): **30.5**
 WEIGHT (pounds): **374**
 SUSPENSION TRAVEL, F/R (in.): **4.7/5.1**
 BRAKES F/R: **11.41-in. disc/8.66-in. disc**
 TIRES F/R: **110/70-17/130/70-17**
 0-60 MPH (sec): **7.23**
 40-70 MPH (sec): **6.33**
 QUARTER-MILE (sec/mph): **15.56 @ 82.5**
 60-0 BRAKING (ft): **129**
 PM FUEL ECONOMY (mpg): **59.7**

!
A deserted stretch of curvy road. Even better: a racetrack.

Superbike of our test machines, the Ninja 250R is a high-winding hoot to ride, thanks to a short-stroke parallel twin that spins past 10,000 rpm and sings the sweetest note this side of an F1 car. It delivers too—the Kawie was the quickest bike by a wide margin and the only one with the power to keep up with (and perhaps pass) commuters cruising at 75 mph. Flip side? The engine's high freeway revs (8000 to 9000 rpm) sometimes make the Ninja feel like it's a blender set to Frappe, and its 59.7 mpg was low for this group. Compared with the otherwise similar Honda, the Ninja feels naughtier and more willing to play hard. The suspension is firmer, the brakes are grabbier and the bike wants to explore its limits—and yours. But because it's just a 250, you won't get into much trouble. The Ninja is so good, you could buy it as your first bike, hang on to it and continue enjoying it as your skills improve. We want one.

pants. If it's warm where you live, there are plenty of light, breathable jackets available that are fully armored with pads—so there's no excuse to leave home without protection. And remember, even though the camaraderie among bikers is strong, always ride within your limits—not someone else's.

The bikes used in MSF classes are easy-to-manage 250-cc machines. "If you're new to street riding, you really want to start small, on a bike like one of these," says Ty van Hooydonk,

director of communications at the MIC and a certified MSF RiderCoach. "You'll have a much easier time developing your skills on a nimble, responsive motorcycle that won't overwhelm you."

There are 250-cc bikes representative of every motorcycle type, from cruisers and sportbikes to standards and supermotos. So there's a good starter bike waiting for just about any rider. The best part? Many of these bikes are so much fun, they might earn a stall in your stable long after you've

graduated to more powerful iron.

We gathered six terrific 250-cc starter bikes and tested them at Auto Club Speedway in Fontana, Calif., with professional test rider Danny Coe, along with senior editor Mike Allen and contributing editor Basem Wasef, to find out which ones were quickest down the quarter-mile and which ones stopped in the shortest distance. We tested fuel economy on a route that combined highway, city and country roads near Los Angeles. And then we took the machines to Glendora Mountain Road, a tight and technical two-laner that challenges both rider and bike. (Yes, it's a great way to spend an afternoon.) And we found each model here has enough comfort, power and efficiency to be a great first bike. So which ones suit you and your riding style best? Let's find out.



HONDA CBR250R



STATS

PRICE: **\$3999**
 POWERTRAIN:
249-cc liquid-cooled single/6M
 WHEELBASE (in.): **53.9**
 SEAT HEIGHT (in.): **30.5**
 WEIGHT (pounds): **359**
 SUSPENSION TRAVEL, F/R (in.): **4.65/4.07**
 BRAKES F/R: **11.65-in. disc/8.66-in. disc**
 TIRES F/R: **110/70-17/140/70-17**
 0-60 MPH (sec): **7.85**
 40-70 MPH (sec): **7.84**
 QUARTER-MILE (sec/mph): **16.11 @ 77.6**
 60-0 BRAKING (ft): **121.6**
 PM FUEL ECONOMY (mpg): **71.4**

! Nearly anything that's paved, especially sinewy blacktop.

For those who find the Ninja's hot-blooded, rev-happy twin a bit too spicy, the Honda CBR250R's mild and torquey single might be more palatable. The smooth 249-cc single-cylinder moves the feathery 359-pound CBR easily off idle and into traffic compared to the free-revving Kawasaki. The Honda is generally the more docile bike. "The CBR's fuel injection is going to make things easier on beginners," van Hooydonk says, "since there's no choke. Plus, the \$500 antilock brakes remove the worry from panic stops." The riding position is upright, natural for a taller rider, and a comfortable one for most riders. That lone piston returns over 71 mpg—but it buzzes on the freeway. The CBR is new this year, and it looks like a mini VFR Interceptor, one of Honda's hottest bikes. The Ninja might be the more fun and eager companion on a tight, winding road, but this Honda is the good-natured sportbike—it's the golden retriever that wants to bring you home safe.

KAWASAKI KLX250SF



STATS

PRICE: **\$4999**
 POWERTRAIN:
249-cc liquid-cooled single/6M
 WHEELBASE (in.): **55.9**
 SEAT HEIGHT (in.): **33.9**
 WEIGHT (pounds): **302.1**
 SUSPENSION TRAVEL, F/R (in.): **9.1/8.1**
 BRAKES F/R: **11.81-in. disc/9.45-in. disc**
 TIRES F/R: **110/70-17/130/70-17**
 0-60 MPH (sec): **8.38**
 40-70 MPH (sec): **8.96**
 QUARTER-MILE (sec/mph): **16.47 @ 75.4**
 60-0 BRAKING (ft): **120.47**
 PM FUEL ECONOMY (mpg): **67.4**

! Surprisingly entertaining on twisty roads, but also well-suited to light off-road duty.

The KLX is a supermoto, essentially a dirt bike with sticky street tires and big, beefy brakes, so its suspension soaks up the worst potholes and broken pavement. But the biggest thrill (and surprise) is when the road twists—the KLX loves curves. It's so lightweight (about 300 pounds) and steers so directly that you can follow a Ninja 250R through the corner and probably pass it on the dirt shoulder. The KLX, however, has some shortcomings. First, the tank holds only 2 gallons, so the range is roughly 115 miles. But that's probably a good thing, because if you sit much longer, the narrow, hard seat makes you sore. Although the KLX has clear and upscale digital gauges, the minimal bodywork and upright seating position conspire to make highway riding feel like zipping along at 60 mph on your dining room chair. But it's a blast to ride in all terrain—another bike that you could keep around and never be at a loss for weekend thrills.



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YAMAHA V STAR 250



STATS

PRICE: \$4090
POWERTRAIN:
249-cc air-cooled
V-twin/5M
WHEELBASE (in.): 58.7
SEAT HEIGHT (in.): 27
WEIGHT (pounds): 324
SUSPENSION TRAVEL,
F/R (in.): 5.5/3.9
BRAKES F/R: 11.1-in.
disc/5.1-in. drum
TIRES F/R: 3.00-18/
130/90-15
0-60 MPH (sec): 9.38
40-70 MPH (sec):
10.83
QUARTER-MILE (sec/
mph): 16.98 @ 72.1
60-0 BRAKING (ft):
131.43
PM FUEL ECONOMY
(mpg): 81.0

!
 Boulevards
 where you can
 let the V-twin
 bark.

A

low, 27-inch seat and effortless low-speed maneuverability make the V Star 250 one of the least intimidating bikes sold today. "Beginners often like being able to put both feet on the ground at stoplights," van Hooydonk says. The Yamaha has been kicking around since the late 1980s (as the Virago 250), so the company has had plenty of time to smooth the rough edges. It shows. The 249-cc V-twin and five-speed transmission don't mix for a speedy cocktail, but there's enough juice to have some fun on the back roads. And who would have guessed that the V Star emerged as one of the most entertaining here? It's simply so nimble and so well-dialed-in that you end up using every last ounce of its admittedly low performance. Trust us, taking advantage of all of a starter bike's capability is way more exciting—and rewarding—than never exploring the outer limits of a superbike. And how about this—it also returned 81 mpg.

SUZUKI GZ250



STATS

PRICE: \$2999
POWERTRAIN:
249-cc air-cooled
single/5M
WHEELBASE (in.): 57.1
SEAT HEIGHT (in.): 27.8
WEIGHT (pounds): 331
SUSPENSION TRAVEL,
F/R (in.): 4.7/3.5
BRAKES F/R: 10.8-in.
disc/6.1-in. drum
TIRES F/R: 110/
90-16/130/90-15
0-60 MPH (sec): 11.51
40-70 MPH (sec): N/A
QUARTER-MILE (sec/
mph): 18.01 @ 67.4
60-0 BRAKING (ft):
132.35
PM FUEL ECONOMY
(mpg): 68.9

!
 In-town errands
 and the local
 cruise night—
 avoid freeways.

L

little GZ started out as the Rodney Dangerfield of this group—no respect. And, yes, it does have shortcomings. The wheezy 249-cc single sounds unsophisticated and doesn't offer much oomph. It's nearly VW Microbus slow and requires full throttle to crest hills. But oddly enough, around town you don't notice its pokiness. Like the V Star, the Suzuki surprised a few riders with its athleticism and easy handling. "I found the GZ250's seat-to-grip relationship a little less spacious than the V Star's," Wasef says. "But I felt more in control of the bike, thanks to the sportier handlebars." After a long day of riding, all appreciated the Suzuki's comfy seat. We like this bike, but it's simply too underpowered to confidently tackle freeways, since it takes forever to pass anything. Off the highway, the Suzuki is incredibly friendly. It returned almost 70 mpg and costs less than three grand. **PM**

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EXPRESS

»»» The 2011 Pop Mech Top Shop: An All-New Adventure



t its heart, car customizing is about passion: a passion for style, a passion for speed, a passion for doing things right.

But it takes more than just love to get a car built—you have to have mechanical skill and a talent for seeing a solution where most people only see a problem. You also have to have the determination to see a project through. That may not sound like a big deal, but when you're months or years into a build, surrounded by piles of parts, it can be hard to see the light at the end of the tunnel.

Ordinary people don't jump into this sort of thing lightly, at least not if they have any sense. Restoration and custom shops do it every day, but the hurdles they face aren't lessened because they've seen them before. Add in normal business problems like crazy customer demands and parts that don't fit, and you've got a recipe for a headache.

Last year, we put one shop to the ultimate test: We took that headache and put it under the spotlight. After conducting a nationwide search for a custom shop capable of turning a 2010 Chevy Camaro SS into something special, we settled on Netcong Auto Restorations of Netcong, New Jersey. Phil and Dana Brazer, the shop's owners, then subjected themselves to our cameras, our deadlines and the harsh glare of scrutiny, attempting to create a spectacular machine from ordinary street muscle. The car that resulted was amazing—it featured futuristic styling, a thundering supercharged V-8, and enough chassis modifications to shame many purpose-built race cars. The accomplishment was made all the more impressive by the fact that the Brazers were relatively new to the business—at the time, their shop was only a year old.

This year, we approached the project a little differently. We liked how the Brazers did things, so we threw them a new challenge: If the Camaro was about no-compromise speed, then for 2011, we

wanted style and comfort to come first. We wanted a road-trip monster, something that reminded us of the laid-back customs of yore. We wanted the ultimate weekend getaway car, something you and your special someone could drive off into the sunset.

To that end, we bought a brand-new 2011 Ford Mustang convertible, a red-on-black GT equipped with Ford's 5.0-liter "Coyote" V-8. The 5.0 is Ford's top Mustang engine, and it uses 32 valves, variable valve timing, and overhead cams to produce a whopping 412 hp. As for the convertible—well, what better way to see the country than with the open sky above you? At just over \$34k out the door, the GT can hang with many supercars without breaking the bank. We dropped it off at Netcong and told them to start planning.

But our project, and the challenge it brought, didn't stop there. We wanted to be able to roam when we wanted, to mix things up after hitting our weekend destination. A motorcycle was needed, something big on style and comfort without sacrificing speed.

Enter the Victory Motorcycles 2010 Hammer S: old-school looks and a modern, 97-hp V-Twin. Victory prides itself on producing thoroughly modern machines that provide traditional cruiser thrills. Inverted front forks and dual-disc front brakes are standard, so the Hammer S stops and turns like a real bike, not an outdated relic. It also comes with a 250-mm rear tire, a rubber steamroller that helps put all that power to the ground. We ordered up an aluminum motorcycle trailer and told the Brazers to start thinking about fitting a hitch to the Mustang. We also asked the Netcong crew to dream up ways to make our Hammer S more comfortable and long-legged on the highway.

Back to the car. Last year's Camaro was



FORD MUSTANG GT CONVERTIBLE

Year: **2011**

Engine: **5.0L 4VT, VCT V-8**

Horsepower: **412**

Displacement: **302 cubic in.
/ 4,951cc**



VICTORY HAMMER S

Year: **2010**

Engine: **4-stroke 50° V-Twin**

Horsepower: **97**

Displacement: **106 cubic in.
/ 1,731cc**

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RS3-S

RS3-A



designed by Phil, with Dana contributing vital sketches and the Netcong team tweaking things during the build. This year, we threw a wrench into the works: We asked Grant Brazer, Phil and Dana's 14-year-old son, to get involved. This wasn't a whim—Grant showed a keen eye for design during the Camaro project, and he helped his father with some of that car's finishing touches. He's also a product of the digital age—he learned Photoshop and computer-aided design a few years ago in summer camp and has been digitally “drawing” cars ever since.

“It's amazing,” Phil says, beaming the smile of a proud father. “Dana and I have a corporate background, and we know the design tools. But Grant has already exceeded our abilities in most ways. He's got a good eye—a much better eye than I do.”

Sitting in the paint booth, our Mustang is a shell, an interior-free piece of art that looks more like a dream than a real car. It's menacing but slightly whimsical, with an old-school attitude that reminds you of George Barris's 1960s “kustom” lineup. A massive hood scoop, cut and welded from the stock hood bulge, lives in front of the windshield. Functional brake ducts in the rear fenders give you an intimidating view of the GT's meaty rear rubber. A knife-edged “ducktail” spoiler, also fabricated from steel, juts up off the trunk lid. Six rectangular headlights, arranged vertically and fitted to custom-fabricated housings, echo the Mustang's stock taillights and provide a bit of futuristic flair.

Polishing compound is everywhere, the paint having just been buffed following a wipe-down. Candy-flake yellow paint, laid over the red base and filling in the factory body accents, reminds you of new-think customizers like Chip Foose. You can see the

finished product in there, but it's still a long way off.

“We first started out with an idea like a snake pattern down the side, something keying off of Ford's Super Cobra history or something,” Grant says. “We even thought about wrapping it or painting scales on it, just for fun. Then my dad, who's a composer and musician, gave me an idea—he said, ‘How about a sunburst guitar?’ I experimented with that, we loved it; and I came up with the final colors that way.”

It's taken a lot of work to get to this point, and Netcong isn't done yet. Deadlines still loom and photography appointments are around the corner. On top of that, the Mustang doesn't have an interior, and our weekend-getaway goal is going to require more than just bolting the stock stuff back in. We've got some special plans, including what we're going to do to the Hammer S, and we've looped in some special contributors.

Like most shop owners, the Brazers believe their staff separates them from the pack. Last year, we pointed out how Netcong was getting more out of its employees than most, using what Phil called a “traditional six-sigma approach.” Basically, this means that each shop technician has a specialty, something he's the best at in the shop. He leads the way on that particular part of the project—bodywork, mechanical fit and finish, and so on—while carefully incorporating other employees into the mix. In this way,

***He's got a good eye—
a much better eye
than I do.***



» In the beginning, we didn't think Grant Brazer's ambitious plans for our Mustang GT could be translated into real life. In this case, it was nice to be wrong.

BRIGHT AND LIGHT

COOPER LIGHTING

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If you're building a custom car, you spend a lot of time poking around in dark places. Cooper Lighting's compact LED Might-D-Light helped illuminate our Mustang's crooks and crevices. Its lightweight folding construction lets you store it easily, and the

two Cree LEDs produce a combined 170 lumens. A six-hour battery life keeps you working without recharge breaks, and three high-strength neodymium mounting magnets let you keep both hands on the job.

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Netcong's roster has changed a bit since our last encounter, but the philosophy remains. Just as important, the Netcong guys are hard-working, and they respect each other immensely.

Next up are Ray Dziadul and Will Siedenburg. Ray focuses on mechanical assembly and bodywork and is partial to '70s Mopar muscle. Will spent 40 hours

Then there's Hal Haley, who owned and operated the shop before selling the assets to the Brazers in 2008. He's worked in this business for 43 years, and he owned Netcong Auto Refinishers/Netcong Auto Body—for 15. He's seen everything from six-figure classics to large boats come through his paint booth, and he once fought with the town of Netcong to get permission to bring a helicopter into the shop. ("They said it wasn't a car, that 'auto body' meant just autos. But if you look at the state regulations, it's entirely legal. It fit into the booth pretty easily.")

Hal runs the day-to-day business for the Brazers. When he talks about the guys he works with, he's genuinely impressed.

The Mustang's six rectangular headlights were built into a custom-fabricated housing that echoed the stock taillight arrangement. Making them fit was harder than it looks.

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teardown and rebuild of the vehicle in question. The 50-year-old company currently offers over 500 manuals—over 300 devoted to cars, and over 200 devoted to motorcycles and ATVs.

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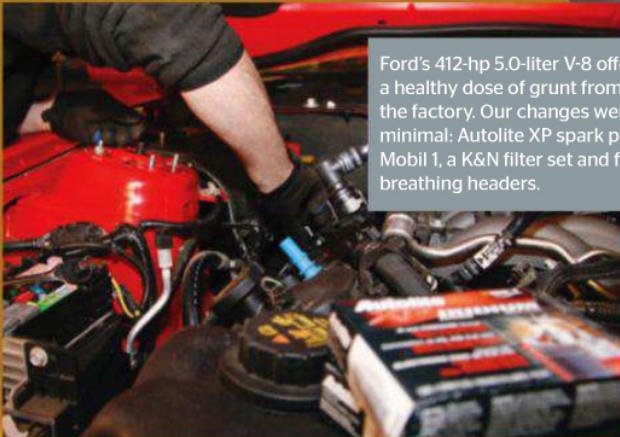
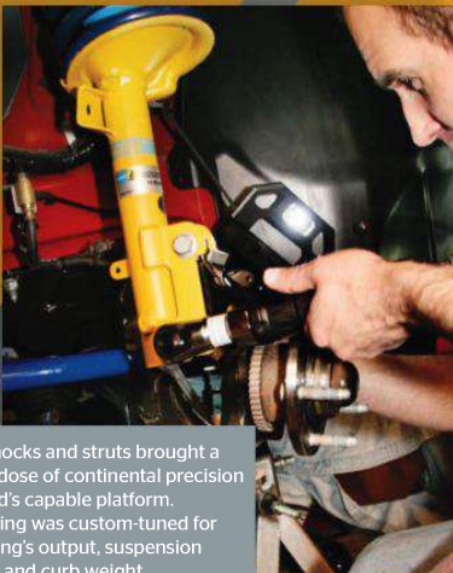
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Ford's 412-hp 5.0-liter V-8 offers a healthy dose of grunt from the factory. Our changes were minimal: Autolite XP spark plugs, Mobil 1, a K&N filter set and free-breathing headers.



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"Everything here is a total team process," he says. "Everyone chips in, and every person here can do exactly what the next guy can do. Maybe one person's a little better at something than somebody else—Craig and Will are excellent body guys, I'm great at painting, Ray's an incredibly talented fabricator. There's a reason we have a wide range of talent."

As with last year, Netcong's professionalism was a draw, and it made

even, we were changing things a lot because certain parts didn't look right. We were taping the side of the car up to see what we could do with accents or stripes, that sort of thing. It was a lot of fun."

Grant's design was nothing short of radical. That aggressive, menacing hood scoop was crafted by Ray from the stock hood's steel, opened and rewelded to be functional. It looks like a factory piece. The three vertical lights in each headlight bucket are custom high-intensity lamps chosen for their compact size and broad, well-defined beams. They were fit into a custom-built housing, and the grille was tweaked for a more rakish appearance. And because our weekend getaway would likely require heading out into the wilderness, we equipped the Ford with a set of auxiliary LED driving lights. They're smaller than



them an attractive shop to work with. But the creativity sealed the deal, and a large part of it came from Grant.

Ford restyled the Mustang in 2008, building on the retro cues it introduced to the car a few years before. Grant's design incorporated those cues but amped them up, giving our 'Stang the cool feel of a car out of time. It's old, new and everything in between. It was also, up until the end, a work in progress.

"I like custom stuff because it's different from designing a regular car," Grant explains. I like the fact that, with a project like this, I could go up to the shop and watch it happening. Toward the end of the paint job,

most factory units but surprisingly bright.

As you might expect, projects like this are defined by the details. Grant's design drawings specced a ducktail spoiler so radical—it appeared to have been drawn out like rubber, one of the fun capabilities of Photoshop—that we initially wondered if it could be translated into real life.

Amazingly, Ray made it work. He crafted the entire thing from steel, welding and tweaking it into existence. Will prepared it for paint.

"It was a little more time-consuming than I thought it would be," he notes, "just because there were so many contours. You fill and sand to get the right shape, and it's

TOP SHOP

TIP No 01 ★ ★

Garages are dirty places, and shop manuals tend to take a lot of abuse. If you have a repair manual you don't want to get oily or greasy, photocopy the pages you need and take the copies into the garage. Your bookshelf will thank you, and your manuals will last longer.

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MechanixWear offers a wide selection of high-performance shop gloves, but we prefer their Original Plus, which offers a raised thumb-and-finger pattern for improved traction. A form-fitting Spandex back and finger inserts mean that you'll never want for comfort, and an index-finger knuckle

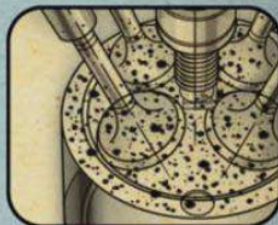
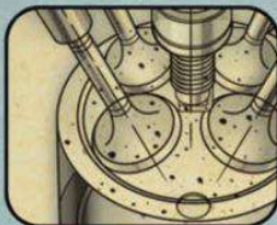
reinforcement keeps you protected from common scrapes and bruises. If that weren't enough, the Original Plus offers improved cuff and thumb fit for easy entry and increased flexibility. Can you tell we care about our hands?



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right in one place but wrong in another. Then sand it there and something else isn't right ... it's just a drawn-out process, getting all the contours to match."

But he did it. The end result arcs up off the trunk like the prow of a ship and integrates seamlessly with the 'Stang's rear fenders. Throughout all the sanding and shaping, Ray's keenly crafted edges were kept—when the Ford's trunk is open, you tend to walk carefully around the spoiler's fender "points" so as not to impale yourself on them. (It's safe, really. It just looks dangerous, which we love.)

In chopping the roof off the Mustang, Ford reinforced the chassis to cope with the loss of rigidity created by an open top. These reinforcements add weight, and weight taxes brake components. The speed modifications we're planning to make will do the same.

For this reason, Grant added a feature his dad initially designed for the Camaro: functional rear brake ducts. Ray cut these out of the side panels and laid them in, carefully preserving the car's swage lines and profile. They're a nice piece of work, invisible from the side but readily apparent from the

front. Three-strip LED tail lights on each side echo the vintage-think stock arrangement but provide a modern touch; a custom center backup light, flush-mounted in the rear valance, is brighter and more visible than the tail lamp-mounted originals.

All of this sounds suspiciously well-planned for a guy who can't even drive yet. But Grant thinks older than his age would have you believe. Even now, he's planning his future.

"I like thinking about this stuff, and I'd like to work in car design," he says. Ask him about his design process, and he'll tell you that he works with pretty basic tools. "I use the earliest version of Adobe Photoshop that there is," he says, modestly grinning. The results speak for themselves.

Unsurprisingly, Grant's parents support his efforts. "His drawing is phenomenal, and we like to encourage that," says Phil. "But he likes dabbling in different things, and we want to help him get there. When we bought the business, he got into cars without any pushing from us.

"The project changed a lot during construction," Phil continues. "In the



The Mustang's trunk lid and tail light housings saw a great deal of modification. The all-steel ducktail spoiler alone took 70 hours to prep for paint. The result is seamless fit and finish.

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beginning, Grant was submitting design after design, and some of them weren't what we needed. Which I thought was a very good lesson—at first, he put up a little resistance, but within a half-hour or so, he was with the program again, working as part of a team, churning out new drawings. He occasionally got a little frustrated, but he sorted through it pretty quickly. Frankly," he says, laughing gently, "I was amazed at his ability to work within deadlines. It shows a lot of maturity."

All told, the Mustang's trunk saw a lot of work. The trunk opening was reshaped to match the new lights, and new inner light housings had to be built from scratch. The process wasn't without its hiccups. As Craig tells it, "It's always frustrating when you're trying to work against the clock. Assembling all of that without doing any damage? That sort of thing is always a challenge."

Still, this car isn't just about looks. When we gave Netcong our "ultimate getaway" brief, we specified a car that was both stylish and fast. We wanted to be able to carry significant speed to our destination in order to maximize the time for play. At the same time, we also wanted a car that was relatively quiet, with factory reliability, an unbroken warranty and sensible fuel economy. In other words, if you can't get home because the car breaks, why leave in the first place?

For that reason, the Brazers largely left Dearborn's killer V-8 alone. At 412 hp, we'll have more than enough grunt for cruising and stoplight drags. The engine's running Mobil 1 Extended Performance (EP) synthetic oil to minimize power loss and fuel-economy drops from friction, and to maximize the longevity of internal parts under extreme conditions.

While we're talking about chemicals, we're also using Shell's Gumout Regane Complete Fuel System Cleaner, an in-tank

» At Netcong, each employee helps out with all aspects of production and customization. Here, Ray fine-tunes a paint gun outside the spray booth.

The blending and candy-flake fade on the Mustang's flanks took a great deal of planning and effort to execute. Good, old-fashioned masking was part of the process.



STRAIGHT SHOOTER

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Refinishing isn't easy, and if you don't have good stuff coming out of your spray gun, it's even harder. Dupli-Color's easy-to-use Paint Shop system offers no mixing and no reducing—all you have to do is pour it out of

the can and go. It's also stable and easy to apply in a wide variety of conditions. We used a mix of red, yellow and orange "candies" to make our retrofuturistic Mustang pop.

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A K&N drop-in air filter was installed in five minutes and provided us with both less restrictive air path and a slightly throatier intake note. Its million-mile warranty was a nice plus.

additive you blend directly with pump gasoline. Some believe you shouldn't use a fuel additive on a brand-new engine, but that couldn't be further from the truth. The secret is the science: Extended cruising and stop-and-go driving, as our Mustang is likely to see, can leave carbon deposits on valves, pistons and intake ports. These deposits restrict intake and exhaust flow and harm both efficiency and power, making the engine work harder and use more fuel to accomplish less. Regane leaves behind a protective shield that prevents deposit build-up.

Not that the engine itself was untouched. Improving an engine's breathing rarely has a negative impact. The washable, free-flow, cotton-gauze K&N air filter we chose dropped into the airbox in five minutes and beefed up the sound of our intake. In keeping with the long-life theme, it's good for up to 50,000 miles between cleanings. A K&N oil filter keeps it company. Because our engine boasts aluminum-alloy heads and a high-output ignition system, we also took the opportunity to upgrade our spark plugs to Autolite XP Xtreme Performance units. They boast an iridium-enhanced, 0.6-mm, fine-wire design and platinum sidewire technology, both of which result in better durability and a more focused ignition.

Last but not least, the car needed a set of pipes. BBK's Ceramic Tuned Length Shorty Headers were chosen because they offered a mellow tone and impressive build quality. A Borla Stainless Steel Cat-Back System S Type capped things off with a nice, rounded growl. Because these parts flow more freely than the stock units, we called SCT and ordered up a custom-tuned SF3/X3 Power Flash Tuner. It'll compensate for the increased exhaust airflow by tweaking the engine's fuel and ignition mapping. The result should be a bump in horsepower and torque.

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A stock Mustang convertible is a decent and predictable handler, but it's ultimately geared toward boulevard cruising. Because our Ford is a GT model, it left the dealer with performance-oriented springs, shocks and sway bars, a step above the equipment found on base Mustangs. But we wanted the best of both worlds—a compliant ride for highway cruising and a taut, nimble chassis for back-road fun. After all, getaways are supposed to be relaxing. Relaxing means fun, and fun means having suspension that can conquer—not just tolerate—any road.

After extensive research, Netcong and the Pop Mech team assembled a suspension package that should offer few compromises. Lowering springs give a mild 1.5-inch ride-height drop front and

rear, and Bilstein struts/shocks add a dose of European precision to our drop-top American muscle. The Bilsteins are high-precision units that use extruded bodies, induction-hardened shafts, and machined valves. They're strong instruments, tuned with the Ford's horsepower, and suspension geometry in mind. Happily they also come with a warranty that'll last the life of our car.

Rounding things out, we ordered a set of Steeda heavy-duty sway bars to tame body roll.

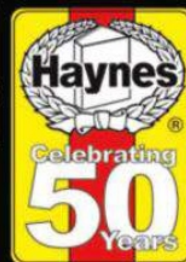
The front bar is adjustable for stiffness, which should let us tailor the Ford's handling balance for the load we're carrying and type of road trip we're on.

At the moment, the Mustang rides high on its stock suspension, a set of black American Muscle GT4 wheels at each corner. Thirteen-inch Big Bite rotors and chrome three-piston calipers from the Stainless Steel Brake Company (SSBC) live behind the front wheels, matched by a chromed SSBC brake kit in the rear. The reason for this upgrade was threefold: First, in the interest of safety, you can never have too much brake. Second, the Mustang's stock braking system, good though it is, could benefit from improved pedal feel and shorter stopping distance. Third, we knew we'd be hauling a motorcycle trailer,

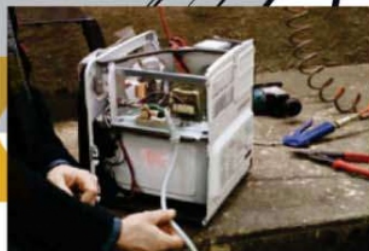
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and we didn't want to worry about brake fade while carrying a load.

All the mechanical work on the car was, and will continue to be, performed using MechanixWear gloves. The crew at Netcong makes their living off their hands, so they try to protect them as much as possible. Thankfully, Mechanix gloves are geared toward practical use as well as protection, which means key features like rubber-tipped fingers and a form-fitting spandex back are common.

With the bodywork coming to a close and the interior and convertible top removed—the cockpit's in for a serious makeover, which we'll address in a moment—the only thing left was rubber.

Tires are the most important part of a car's suspension, and not a decision we took lightly. As the only part of the car that actually touches the pavement, they're responsible for everything from acceleration and braking performance to road noise and wet-weather stability. The right rubber can maximize any chassis upgrade; the wrong choice can turn a stable, confidence-inspiring machine into an ill-handling beast.

After our positive experience with the Cooper tires on last year's TopShop Camaro, we decided to repeat the experiment with the Mustang. On

our closed handling course, Cooper's Zeon RS3 performance tire was worth two seconds over the Camaro's factory tires. The RS3 was originally developed for Roush's high-power custom Mustangs, and until this year, it was the highest-performing tire that Cooper offered. Frankly, we were amazed with its capabilities.

But time marches on, and few things move as quickly as automotive technology. In the interest of science, we asked Cooper for their latest top-of-the-line tire. The RS3's successor, the race-inspired RS3-A, offers an asymmetric tread pattern and a sidewall construction that delivers crisp handling and precise steering response. Unlike most high-performance tires, the RS3-A manages this without sacrificing wet-weather performance—a specially-designed silica rubber compound and large central grooves help clear water in inclement weather. Large outer tread blocks offer sharp turn-in and stable cornering. All told, it should pair nicely with our suspension upgrades.

Given the RS3-A's performance capability, we felt comfortable not going for the most aggressive tire size that would fit under the Mustang's fenders. Thin sidewalls give greater steering feel and let the suspension do more of the work, but they also

Our interior plans include a functional coffee maker and microwave and a lack of a back seat. Butler, New Jersey's Creative Auto Interiors was tapped to make these things a reality.

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Kicker's weatherproof coaxials are perfect for motorcycle use, which is why we went with a 4-ohm set of their lightweight, neodymium-magnet drivers. Each speaker weighs just 12 ounces and is designed to be heard over road

noise and helmet wind rush. The Mustang is rocking a complete Kicker OEM upgrade kit, a plug-and-play solution that offers a lighter subwoofer and easy-install factory connectors. Two wheels or four, you'll hear us from a mile away.





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Steve sewing, stamping and cutting—it all takes patience, time and dedication.



In order to properly integrate electronic components, Rodger Pisani and his interior crew dismantled the Mustang's dash.



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Chris installing LED lights. The Mustang's paint job makes it visible from 5 miles away; the lights should double that distance.



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transmit more road-impact harshness to the cabin. By contrast, fat sidewalls trade off grip for cushiness, effectively softening the car's spring rates. The 245/45-18s we fitted should offer a nice blend of old-school appearance and modern capability. If we're right, the result will be a healthy dose of grip befitting a long-legged convertible, not a rough-riding track rat.

With the car's chassis planned, we turned to the upholstery team responsible for the TopShop Camaro. We needed someone with a creative eye, years of interior experience, and a flair for the unusual, so we called a man who lets a pet rabbit run free in his shop. We called Rodger Pisani.

Yes, that's right—a rabbit. Pisani's Butler, New Jersey-based Creative Auto Interiors does a lot of work for restoration shops and many of New York's luxury car dealers. And among all those high-dollar

school wasn't in session. Naturally, Mrs. Pisani thought of home.

"I told my wife, 'you're not bringing that stinky animal in the house,'" Rodger says. "We had a big argument. I ended up compromising and putting it in a cage at work. I hated the rabbit, and because of all the shop noise, the rabbit basically hated me. It tried to bite me—no, wait, it actually bit me. And it peed on me."

That summer, things changed. "I fell in love with the stupid thing," Rodger says, grinning. "It became my buddy, and it would follow me around the shop, always tuggin' on the back of my pants leg, wanting to be petted. It was a really cool rabbit."

To make a long story short, that rabbit eventually passed away, and another one found its way into the shop. It wanders around between reams of fabric and whirring sewing machines, adding a subtle, laid-back

vibe—just the feeling we asked Creative Auto Interiors to build into our Mustang. It also says something about Rodger and his approach to creative projects: A man who lets a wild animal run free around his shop has to enjoy the unexpected.

Rodger's challenge was this:

Because the Mustang was being designed to take two people for a fun, relaxing weekend, it needed to offer all the comforts of home on the road. This could include anything from a portable kitchen to an entertainment unit, but it had to fit within the confines of



exotics is a small white rabbit, calmly hopping around the shop floor. Rodger's wife is a kindergarten teacher, and a few years ago, her students kept a pet rabbit in the classroom. That rabbit needed a place to stay in the summer and during holidays, when

TOP SHOP

TIP №02 ★★

If you want to maximize the effectiveness of a fuel additive, put it in your tank before a fill-up. Use up that tank of fuel, and then change your oil. The oil change will remove any oil-borne deposits loosened by the additive, ensuring that your engine's insides are as clean as possible.

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Most likely, Dupli-Color never envisioned us seamlessly replicating the Mustang's paint schematic on our Victory Hammer S.



the Ford's body and not get in the way of the handling or the car's raucous personality. On top of that, the Mustang's many added accessories would require a complete custom interior so that everything fit and worked

backgrounds are an amazingly good fit for our project. To wit:

Chris: "I've always been a car buff. When I was in high school, I had Fox-body Mustangs. I was messin' around with 'em, soupin' 'em up, racing them at the track. And I like what I do. Every job, every car, every interior is different. The Mustang? This is what a Mustang should be. It's a real 5.0, not the old 4.6. It just seems right."

Steve: "I've always had trucks, but I like sports and muscle cars. I like stereo work, like custom work. I like to get in the car and build something that's not supposed to be there."

The pow-wow among Chris, Steve and Rodger produced some ambitious plans. Once the Mustang leaves the Netcong paint booth, it'll be installed in the Creative Auto Interiors main bay. The rear seat and seat-belt mounting towers will come out and be replaced by a virtual kitchen and storage area for camping and cooking gear. The trunk will become an entertainment mecca, a place to go for relaxation when off the road. In keeping with the Ford's exterior style, the interior will reflect the car's color scheme.

"Some of it came out of laughing and joking around, but it actually made sense," says Rodger. "We thought, 'hey, let's throw a coffeemaker in there, you gotta have a cup of coffee on the road,' but it clicked, and it inspired other things. The theme came from there." To make all this happen, the rear seat won't be a rear seat. That area will house a small microwave, a flip-up refrigerated storage area, a coffee maker and custom-built enclosures for various types of camping gear. Custom red and yellow LED lighting will illuminate the underside of the car. All of it will need to be screwed down hard enough to cope with the grin-inducing handling we're aiming for.

TOP SHOP

TIP No 03 ★ ★

When ordering car parts online, double-check that the part you've chosen is correct. Many times, the manufacturer will stamp an ID number directly into the part itself, and that number can be used to identify a replacement. Above all, don't install something you're not sure about—use often renders parts unreturnable.

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cohesively. All the planning and construction would have to be done with the interior in pieces, as it was removed from the car prior to painting. It's not an easy task.

"I'm a very visual person," Rodger explains. "I want to see what something looks like before I build it, and I want to like it first." He put the seats up on a bench and started sketching directly on the leather with a piece of chalk. He pulled out fabric and hung it over various parts of the car. And most importantly, he sat down and brainstormed with his team.

That team was a key part of the process. The two men who work alongside Pisani are fairly young, and not the kind of guys you expect to have a passion for custom interiors. Chris Watt, 30, is from Butler and specializes in upholstery repair and fabrication. Steve Newton, 32, is from nearby West Milford and focuses his time on out-there electronics installations and digital integration. They're wizards who work clean, and their



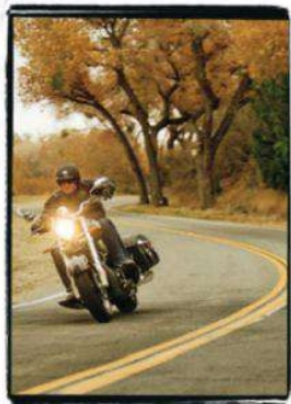
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A highway fairing and LED lighting will help spice up the Victory's looks.



The Hammer's color-matched saddlebags will house stereo equipment and other road goodies.

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Moving on to the rear, a 22-inch TV monitor will be installed in the underside of the trunk lid. Custom folding chairs will also make an appearance, matched to the interior fabric, as will a DirecTV portable video system, a Playstation 3, a wireless speaker system, a custom Stanley integrated toolbox and storage unit, a Kicker OEM-compatible stereo package and lightweight subwoofer... the list goes on. Also on the list will be an Escort Passport LoJack System and Q145 radar detector, the better to keep you informed of what's happening around you. If you get hungry, bored, arrested or ripped off in this car, you're just not trying hard enough.

For now, most of the cool tricks are in the planning stages. But they won't stay there for long.

That leaves our brand-new Victory Hammer S. As it sits, the Hammer makes a few concessions to street-bike norms. It's pretty, but like most showroom-fresh machines, it's also somewhat conventional. And while you could go cross-country on it, it's a production bike, and thus geared toward compromise. For starters, there's a lot of windblast on the highway, the bike doesn't have a stereo system, and the seat isn't designed for extensive two-person travel.

For this, Rollin' Fast Cycle Sports, of Lebanon, New Jersey, was drafted. Rollin' Fast is a Victory dealer and media test-bike manager, as well as a vendor for Polaris all-sport vehicles. (Polaris is Victory's parent company.) When we approached them with our ultimate getaway plan and briefed everyone on the project, they jumped at the opportunity.

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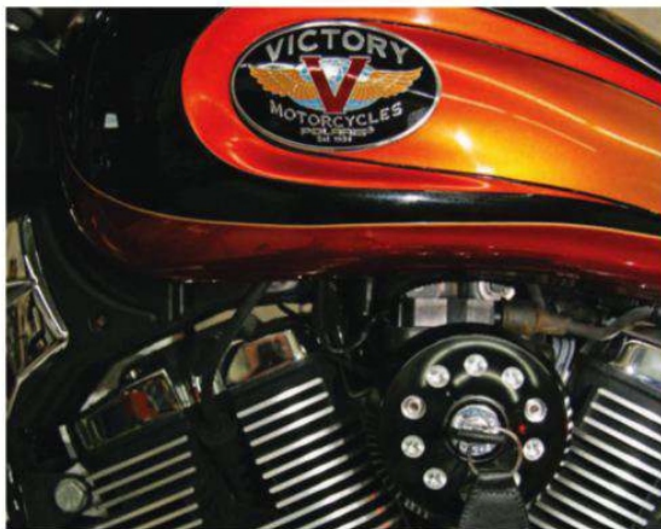


Rollin' Fast owners John Costa and Greg Faiella got their start road-racing 600-cc sport bikes, so performance and style usually take precedence over everything else. Costa, the project leader, is gruff but relaxed. He's the kind of no-nonsense guy you can picture holding court at a race track, but when it comes to customs, his eyes light up.

"I think we're going to start with a few small things," he says. "LED lighting around the engine, for one, tucked-in turn signals, maybe a side-mount license plate." Paint is the first step, with a complex custom finish that will complement Netcong's work on the Mustang. Since the Hammer is a getaway bike, though, it'll need functional add-ons, not just stylish ones. Rodger Pisani's crew is transforming the stock seat into a two-person perch, carving foam and reupholstering to match the Mustang. "We're definitely putting a fairing on it," John continues, noting that the reduced wind noise and added comfort will be suitable for long rides. "It's kind of out of the norm for a Hammer, but it'll also let us incorporate an audio system, which should be cool."

With wind noise tackled, we won't have to leave our tunes behind when we park the car and unload the bike. Kicker's PS5250 coaxial speakers will fit into the Hammer's fairing; their 4-ohm bridged tweeters and neodymium magnets are specifically designed to overpower motorcycle engine and helmet noise. At twelve ounces each, they won't negatively impact performance or handling, and because they're waterproof, we'll be able to hit the road no matter the weather. A CycleSounds Rockbox will serve as a head unit, and a Kicker amp and subwoofer will live in a set of saddle bags. All told, it should provide strong tunes with few drawbacks.

Finally, we need a trailer. Netcong sourced a small Aluma aluminum motorcycle trailer, but it's currently parked in storage. When the Mustang's paintwork is finished, the trailer will roll into the booth and get coated in Dupli-Color flat black. A custom diamond-plate box and motorcycle bracket will round things out. It'll attach to the Ford by way



of a through-bolted, custom-mounted 1-1/3"-inch hitch. There weren't any readily available Mustang hitches on the market, so Performance Trailers of Flanders, New Jersey, modified a common-usage unit to fit the car's rear floor.

The months to come will hold a lot. As the Mustang and Hammer come together on tight deadlines, we'll find out if our chosen shops are up to the task and can handle the pressure. In addition to modifying the Mustang's suspension and building its interior into a home away from home, we'll take a closer look at the details. We'll take you behind the scenes of the Ford's fascinatingly complex multi-stage paint finish, and learn just why paint guys are some of the most patient people on the planet. We'll also look into just what it takes to integrate custom A/V components into a restrictive factory layout.

Once the car is complete, we'll head west for the ultimate weekend getaway, taking our car, bike, and trailer out into the desert in search of some serious fun. Something tells us we're going to find it.



NEXT ISSUE: SEE WHERE THE ROAD TAKES US.

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Most cruisers sacrifice speed and agility for style and comfort. Not the bikes from Victory. The Hammer S is the "muscle" bike of Victory's lineup, an agile, 97-hp speedster that melds old-school looks with new-school technology. Inverted forks, dual

front discs and a modern frame mean the Hammer S handles like a modern bike. A 250-mm rear tire helps put every shred of V-twin power to the ground. All told, it's the best of both worlds—old and new.



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A photograph of a red barn with white trim and a wooden picnic table in the foreground. The barn has a gabled roof, a chimney, and a set of double doors with white X-bracing. A small American flag is flying on a pole near the barn. The picnic table is made of light-colored wood and has a green bottle, a blue cup, and a book on it. A pair of black shoes is on the grass in front of the table. The background shows trees with autumn foliage.

diy

Home

A Moveable Feast

BUILD A PICNIC TABLE THIS SPRING AND ENJOY IT ALL YEAR. *BY JOSEPH TRUINI*

➔ **Summer's nearly here**, and I'm ready for it. I've got a new seven-burner gas grill and four ground-shaking speakers for my outdoor sound system—and I've built a sturdy picnic table to replace my old one. (It was a creaky, splintered mess of lumber that listed to one side like a parallelogram.)

The new table took a weekend to construct, including a trip to a home center to hand-pick the lumber and buy fasteners. One of the project's best features:

INSIDE

×

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The top and bench seats are made from composite decking, a material fashioned from plastic resin and sawdust. It's easy to clean, it's impervious to wood-boring insects, and it never splinters. I chose pressure-treated 2x lumber for other parts of the project—and rust-proof fasteners everywhere. I have to admit that my design is heavy. On the other hand, it's durable; this is probably the last picnic table you'll ever need.

Start at the Bottom

➔ **Begin by cutting** four picnic table legs out of pressure-treated 2 x 6 lumber. Cut two legs at a time on a power miter saw [1]. You can also use a circular saw and a guide to cut the angles on the top and bottom of the legs. Next, crosscut and bevel the seat support and lay the support across the legs. The tops of the supports should be 18 inches from the leg bottoms (as shown in the profile illustration), and the ends of the supports should extend 14¾ inches from each leg. Secure the 2 x 4 supports to the legs with 3-inch deck screws [2]. Later, you'll strengthen the joint with carriage bolts. Be careful to drive the screw head flush but no deeper; otherwise, you risk the screw point poking out the other side.

Now move on to the frame for the tabletop. Crosscut the side rails, and predrill ⅝-inch pilot holes to prevent splitting; join the parts with 3-inch deck screws [3]. Duplicate the process to cut and fasten the seat frames.

The next step is to assemble the picnic table structure. First, position the tabletop assembly flush with the top of the legs and clamp it into place. At each end of the top, drive 3-inch deck screws through the inside of the frame and into the legs [4]. Later, install carriage bolts to bolster the joints. Fasten the seat frames by driving deck screws through the outside of the seat support into the frame [5].

To reinforce the table base and ensure that it doesn't tilt out of square, install two diagonal braces. Use a



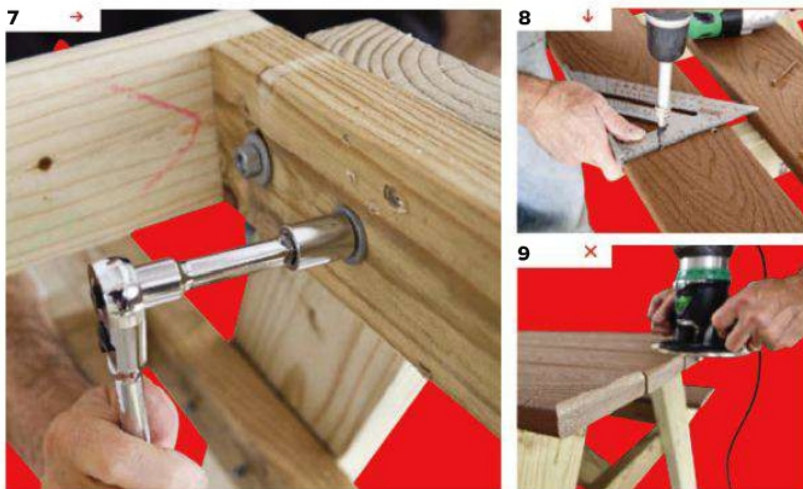
[1] Cut the angle on the legs; gang cuts are faster and more accurate than single cuts. [2] Lay the seat support across the legs and fasten. To prevent twist, lay the parts on a dead-flat surface. [3] Screw the top frame together. Use a simple pipe clamp to hold the parts in position.



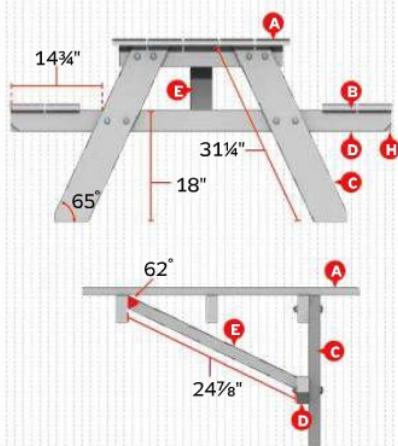
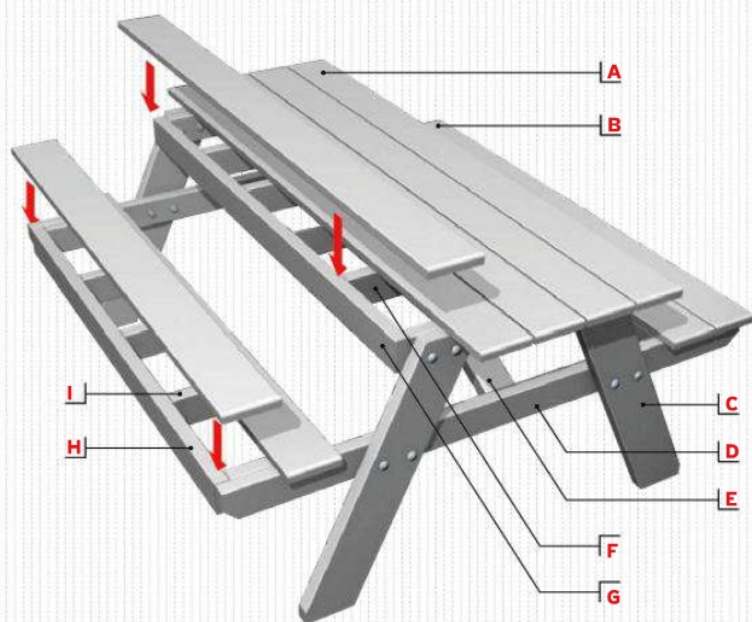
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[4] Fasten the top frame to the legs. Here's where a stubby impact driver really comes in handy, to fit between crossmembers. [5] Fasten the seat frame to the seat support. Be sure the frame is flush with the seat support to ensure that seat planks, well, seat evenly. [6] Fasten the crossbrace. Now the heavy work is done.



[7] Drill for bolts, install the fasteners, then sock down the nuts. You'll probably have to tighten the parts slightly in a few months after the lumber dries out. **[8]** Drill pilot holes in the deck planks. Use a square to align the bit with the frame crossrails. **[9]** Make the decking edges friendlier by rounding them with a router.



Key	No.	Size and description
A	5	1" x 5½" x 72" composite decking (top)
B	4	1" x 5½" x 62¼" composite decking (seat)
C	4	2" x 6" x 31¼" pressure-treated pine (leg)
D	2	2" x 4" x 61" pressure-treated pine (seat support)
E	2	2" x 4" x 24⅞" pressure-treated pine (diagonal brace)
F	6	2" x 4" x 23¼" pressure-treated pine (crossrail top support)
G	2	2" x 4" x 59" pressure-treated pine (long-rail top support)
H	4	2" x 4" x 56" pressure-treated pine (long-rail seat support)
I	10	2" x 4" x 8" pressure-treated pine (crossrail seat support)

Fasteners

3" deck screws used throughout frame → 2½" trim-head deck screws to fasten composite planks → ⅜"-dia x 3½" hot-dipped-galvanized carriage bolts to fasten top and seat supports to legs

Materials List

power miter saw or a circular saw to cut the angled ends on these pieces. Slip the braces between the seat support and top-frame cross support and secure them with 3-inch deck screws **[6]**.

Use a drill and a ⅜-inch-diameter bit to bore carriage-bolt holes through the legs and tabletop frame. To ensure that any splintering occurs on the inside face of the legs, run the bit from the outside to the inside. Use a hammer to tap the carriage bolts through the holes, slide on galvanized washers and nuts and tighten with a socket wrench **[7]**. If you use longer bolts than those I've specified, be sure to cut off any excess bolt shank and file the cut surface smooth. This will prevent the possibility of injury from a protruding shank.

Crosscut the composite decking for the top and seats. To increase accuracy, gang-cut several planks at once. Lay the decking planks across the frame with their woodgrain texture facing up. The planks should have a 5-inch overhang on each end, and the end planks should project 1 inch. Bore ⅜-inch pilot holes through the plank and the frame **[8]**. Fasten the planks with 2½-inch-long trim-head deck screws.

To maintain a uniform ¼-inch gap between the planks, use plastic spacers designed for composite decking. Fit these between each plank.

Finish the project by rounding off the square ends of each plank with a router and a ⅜-inch-radius rounding-over bit **[9]**. Finally, fire up the grill and sit down to your first meal at your new table.

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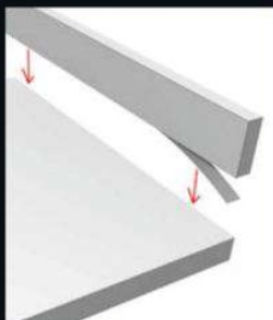
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Kitchen Confidence

We're fixing up our kitchen and, rather than tear everything out, we're going to paint the walls and ceiling, install a new sink and paint the cabinets. I'd also like to build a laminate countertop, but I'm wondering if that's wise. Are there advantages to building rather than buying a counter?



Oversize pieces of laminate are glued down, then trimmed off with a small router or a laminate-trim router. You can use one of two types of bits. One is a flush-trim type with a ball-bearing adapter (shown); the other has the bearing mounted on the shaft of the bit.



←When you build your own counter, you can also build a better backsplash. Cover the bottom edge with laminate first to prevent water infiltration from below. Next, cover the ends, then the face, and finish by applying a strip on the top of the backsplash.



←Rust-Oleum's Countertop Transformations is a \$250 kit that will coat 50 linear feet of counter.

It consists of a wetting agent, preparation and spreading tools, a base coat and silicone-epoxy topcoat, and decorative colored chips that are sprinkled on.

A At PM, we're always glad to see people build their own stuff. It's not going to save you money—it's almost always less expensive to buy a commercially made plastic laminate counter. They're good quality, and they're available in a range of lengths and widths. But building your own counter gives you complete control over its size, shape, color and pattern. You can build counters at various heights (for sitting or standing), you can have overhangs of any shape and dimension, and you can add cool retro details like chrome edge strips (barsandbooths.com). Even if you're not up for building a counter, you can renovate the one you have (see below for an explanation of a new Rust-Oleum process).

One of the most important advantages to building your own counter is that it gives you greater control of the size and design of the backsplash. Unless you buy a counter with an integral (post-form) backsplash, you will almost always see the counter's backsplash delaminate over time. Once that happens, the backsplash will look lousy, and there's no good fix. However, designing a better backsplash is easy: Add a laminate strip to the bottom edge of the backsplash. We show that below.

A plastic laminate counter is not difficult to construct. The substrate is a particleboard panel with buildup strips screwed to its front and back edges; other transverse strips of the same thickness are added to make the counter more rigid. By making the counter look thicker, buildup strips make the counter more attractive, and the robust edge is less prone to damage. You apply contact cement to the mating surfaces of the particleboard and the laminate.



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More than half of all men over 40 have some degree of erectile dysfunction (ED).^{*} If you're one of them, ask your doctor about VIAGRA. It's America's most prescribed ED treatment.

For more information go to viagra.com or call 1-888-484-2472 (1-888-4VIAGRA).

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WITH EVERY AGE COMES RESPONSIBILITY. IMPORTANT SAFETY INFORMATION BELOW.

We know that no medicine is for everyone. Don't take VIAGRA if you take nitrates, often prescribed for chest pain, as this may cause a sudden unsafe drop in blood pressure.

Talk with your doctor first. Make sure your heart is healthy enough to have sex. If you have chest pain, nausea, or other discomforts during sex, seek medical help right away.

In the rare event of an erection lasting more than four hours, seek immediate medical help to avoid long-term injury.

In rare instances, men who take PDE5 inhibitors (oral erectile dysfunction medicines, including VIAGRA) reported a sudden decrease or loss of vision, or sudden decrease or loss of hearing. It is not possible to determine whether these events are related directly to these medicines or to other factors. If you experience any of these symptoms, stop taking PDE5 inhibitors, including VIAGRA, and call a doctor right away.

The most common side effects of VIAGRA are headache, facial flushing, and upset stomach. Less common are bluish or blurred vision, or being sensitive to light. These may occur for a brief time.

VIAGRA does not protect against sexually transmitted diseases including HIV.

Please see Important Facts for VIAGRA on the following page or visit viagra.com for full prescribing information.

^{*}Data taken from the *Massachusetts Male Aging Study*. Of 1,290 respondents, 52% stated that they had some degree of ED.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.FDA.gov/medwatch or call 1-800-FDA-1088.

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IMPORTANT FACTS

VIAGRA®
(sildenafil citrate) tablets

(vi-AG-rah)

IMPORTANT SAFETY INFORMATION ABOUT VIAGRA

Never take VIAGRA if you take any medicines with nitrates. This includes nitroglycerin. Your blood pressure could drop quickly. It could fall to an unsafe or life-threatening level.

ABOUT ERECTILE DYSFUNCTION (ED)

Erectile dysfunction means a man cannot get or keep an erection. Health problems, injury, or side effects of drugs may cause ED. The cause may not be known.

ABOUT VIAGRA

VIAGRA is used to treat ED in men. When you want to have sex, VIAGRA can help you get and keep an erection when you are sexually excited. You cannot get an erection just by taking the pill. Only your doctor can prescribe VIAGRA.

VIAGRA does not cure ED.

VIAGRA does not protect you or your partner from STDs (sexually transmitted diseases) or HIV. You will need to use a condom.

VIAGRA is not a hormone or an aphrodisiac.

WHO IS VIAGRA FOR?

Who should take VIAGRA?

Men who have ED and whose heart is healthy enough for sex.

Who should NOT take VIAGRA?

- If you ever take medicines with nitrates:
 - Medicines that treat chest pain (angina), such as nitroglycerin or isosorbide mononitrate or dinitrate
- If you use some street drugs, such as "poppers" (amyl nitrate or nitrite)
- If you are allergic to anything in the VIAGRA tablet

BEFORE YOU START VIAGRA

Tell your doctor if you have or ever had:

- Heart attack, abnormal heartbeats, or stroke
- Heart problems, such as heart failure, chest pain, or aortic valve narrowing
- Low or high blood pressure
- Severe vision loss
- An eye condition called retinitis pigmentosa
- Kidney or liver problems
- Blood problems, such as sickle cell anemia or leukemia
- A deformed penis, Peyronie's disease, or an erection that lasted more than 4 hours
- Stomach ulcers or any kind of bleeding problems

Tell your doctor about all your medicines. Include over-the-counter medicines, vitamins, and herbal products. Tell your doctor if you take or use:

- Medicines called alpha-blockers to treat high blood pressure or prostate problems. Your blood pressure could suddenly get too low. You could get dizzy or faint. Your doctor may start you on a lower dose of VIAGRA.
- Medicines called protease inhibitors for HIV. Your doctor may prescribe a 25 mg dose. Your doctor may limit VIAGRA to 25 mg in a 48-hour period.
- Other methods to cause erections. These include pills, injections, implants, or pumps.
- A medicine called REVATIO. VIAGRA should not be used with REVATIO as REVATIO contains sildenafil, the same medicine found in VIAGRA.

POSSIBLE SIDE EFFECTS OF VIAGRA

Side effects are mostly mild to moderate. They usually go away after a few hours. Some of these are more likely to happen with higher doses.

The most common side effects are:

- Headache
- Feeling flushed
- Upset stomach

Less common side effects are:

- Trouble telling blue and green apart or seeing a blue tinge on things
- Eyes being more sensitive to light
- Blurred vision

Rarely, a small number of men taking VIAGRA have reported these serious events:

- Having an erection that lasts more than 4 hours. If the erection is not treated right away, long-term loss of potency could occur.
- Sudden decrease or loss of sight in one or both eyes. We do not know if these events are caused by VIAGRA and medicines like it or caused by other factors. They may be caused by conditions like high blood pressure or diabetes. If you have sudden vision changes, stop using VIAGRA and all medicines like it. Call your doctor right away.
- Sudden decrease or loss of hearing. We do not know if these events are caused by VIAGRA and medicines like it or caused by other factors. If you have sudden hearing changes, stop using VIAGRA and all medicines like it. Call your doctor right away.
- Heart attack, stroke, irregular heartbeats, and death. We do not know whether these events are caused by VIAGRA or caused by other factors. Most of these happened in men who already had heart problems.

If you have any of these problems, stop VIAGRA. Call your doctor right away.

HOW TO TAKE VIAGRA

Do:

- Take VIAGRA only the way your doctor tells you. VIAGRA comes in 25 mg, 50 mg, and 100 mg tablets. Your doctor will tell you how much to take.
- If you are over 65 or have serious liver or kidney problems, your doctor may start you at the lowest dose (25 mg).
- Take VIAGRA about 1 hour before you want to have sex. VIAGRA starts to work in about 30 minutes when you are sexually excited. VIAGRA lasts up to 4 hours.

Don't:

- Do not take VIAGRA more than once a day.
- Do not take more VIAGRA than your doctor tells you. If you think you need more VIAGRA, talk with your doctor.
- Do not start or stop any other medicines before checking with your doctor.

NEED MORE INFORMATION?

- This is only a summary of important information. Ask your doctor or pharmacist for complete product information OR
- Go to www.viagra.com or call (888) 4-VIAGRA (484-2472).

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Wipe down the surface of the particle-board before applying glue, and then run your hand over it once the glue has set up to check for chips that might prevent the laminate from firmly bonding to the substrate. Remove any chips that got into the glue.

When the glue has set up so that it's tacky but not wet, position the laminate pieces on the substrate, then trim off the excess laminate using a router and a bit with a bottom-mount ball bearing.

The laminate application sequence is important, by the way. Apply the laminate to the ends of the counter, then to the front and, lastly, to the top.

The Coverup

I'm considering installing carpet over my basement's concrete floor. We've never had problems with basement leaks, but I'm still not sure if it's a good idea. What do you think?

You're right to be concerned. A concrete slab below grade is often cool enough to cause moisture in the air to condense. The vapor can come from people bathing and cooking. It can also come from under the slab or leak into the basement through perimeter drains or from a poorly sealed sump pump. If moisture does condense on the concrete, it will cause carpet to swell and become mildewed.

On the other hand, if the house is relatively new, the floor is insulated (above or below the slab) and the basement is heated in the winter and dehumidified in the summer, then chances are good that you can install carpet without problems.

Chalking One Up

We had an addition built onto our house, and the contractor used red chalk lines to make reference marks on the foundation. At the time, he said the lines would weather away after a couple of months. It's been more than a year, and although the contractor is long gone, the ugly red lines remain. Even pressure-washing has failed to remove them. What else can I try?

Marking chalk comes in various colors.

Blue and white chalk are easy to remove. Red and black are considered permanent—though they fade as they age, they will remain visible. The brighter crimson red and indigo blue are as close to indestructible marks as chalked lines can be. And if pressure-washing doesn't erase the lines, you've got your work cut out for you.

I'd try a masonry etch product that contains acid, such as UGL Drylok Etch (with sulfamic acid) or Krud Kutter Concrete Clean & Etch (with phosphoric acid). This kind of cleaner is powerful, so experiment on a trial area before mopping the stuff all over the foundation. Wear rubber gloves and goggles when scrubbing the foundation with these cleaners, and protect nearby concrete with plastic taped in place or by wetting it thoroughly before you begin.

Think Tank

I've noticed a small crack in the base of my toilet tank where one of the bolts holding it to the bowl passes through. The crack doesn't appear to be leaking yet, or else the leak is so small that the water evaporates from the side of the bowl before it has a chance to do any damage. I suppose whoever installed the toilet tightened down too hard on the bolts. When I install the new tank, how tight do I make the bolts?

I'm glad you're planning to replace the tank. A small crack can suddenly become a large one and result in a major flood. The toilet's fill valve will stay open as water pours from the split tank. If this happens when you're not home, we're talking thousands of dollars in damage.

Toilet tank bolts have to be only just tight enough to make a watertight seal and prevent excessive movement of the tank. It doesn't take a lot of force to pull the tank and bowl together, and you can always tighten the bolt's nut a little more if you find a slight drip. On the other hand, you can't fix a tank or bowl that's been broken due to faulty installation. Kenny Hart, a second-generation master plumber in Virginia Beach, Va., has seen this happen repeatedly. "Nine times out of 10, somebody overtightened the bolts," Hart says, "but there are other causes. I've seen defects in the tank right from the factory, and I've

HOW YOUR HOUSE WORKS

→ Shower

Shower Power

EVERYTHING AN EDUCATED BATHER NEEDS TO KNOW ABOUT THE MECHANICS AND TECHNOLOGY OF A TYPICAL SHOWER.

BY HARRY SAWYERS

→ Plumbing pro Art Slegers

creates an indoor dust storm as he cuts through old tile in a client's Parsippany, N.J., shower. He's wearing goggles, coveralls, gloves, a dust mask and—no joke—a shower cap. His 4-inch angle grinder reveals the guts of the shower supply, a system that remains a mystery to most homeowners despite daily use.

Understanding what goes on back there can help a handy DIYer diagnose a leak, dispatch a vexing clog or—as Slegers is doing—upgrade from an old three-handle system to a modern single-handle valve, which can precisely control temperature without sudden drops in pressure. The replacement is tricky; this is not the time to learn how to sweat copper tubing. But even if you never plan to step into the stall wielding Channellocks and acetylene, it's worth learning how the flow goes.



INSIDE

→ HOT NEW SHOWER HEADS
→ VALVES → DRAINS → RISERS
→ A CURE FOR THE COMMON CLOG

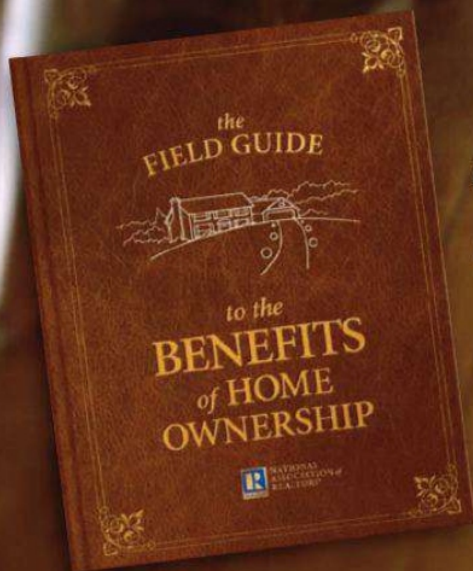
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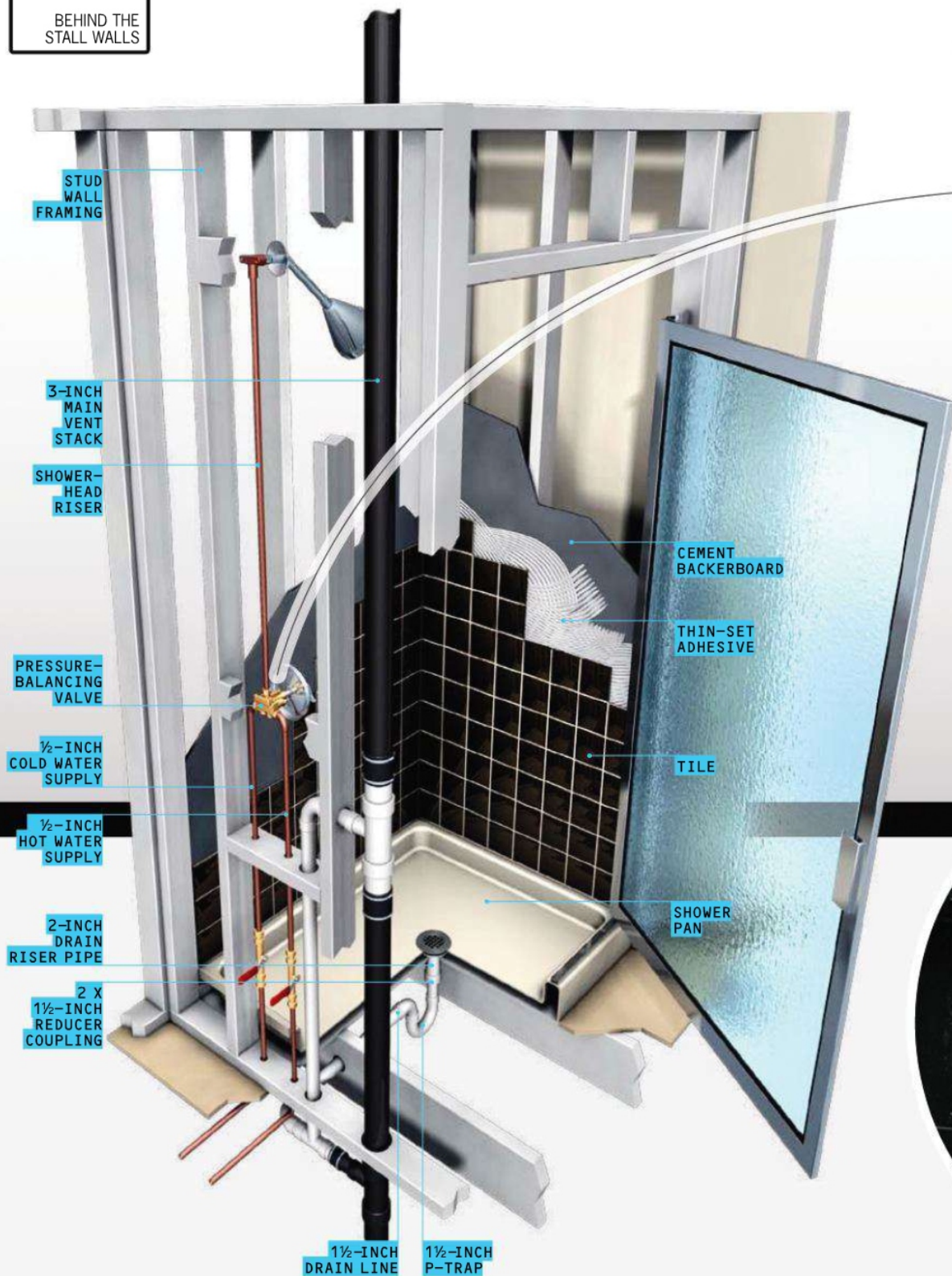
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BEHIND THE
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A PRESSURE-
BALANCING
VALVE EXPOSED



MAKE
IT DRAIN



GRID DRAIN

→ To get hair and scum clogs out of a grid drain, remove the grid screw. Clean the screw threads and mount bar using needle-nose pliers, a bent wire and old scissors.



POP-UP DRAIN

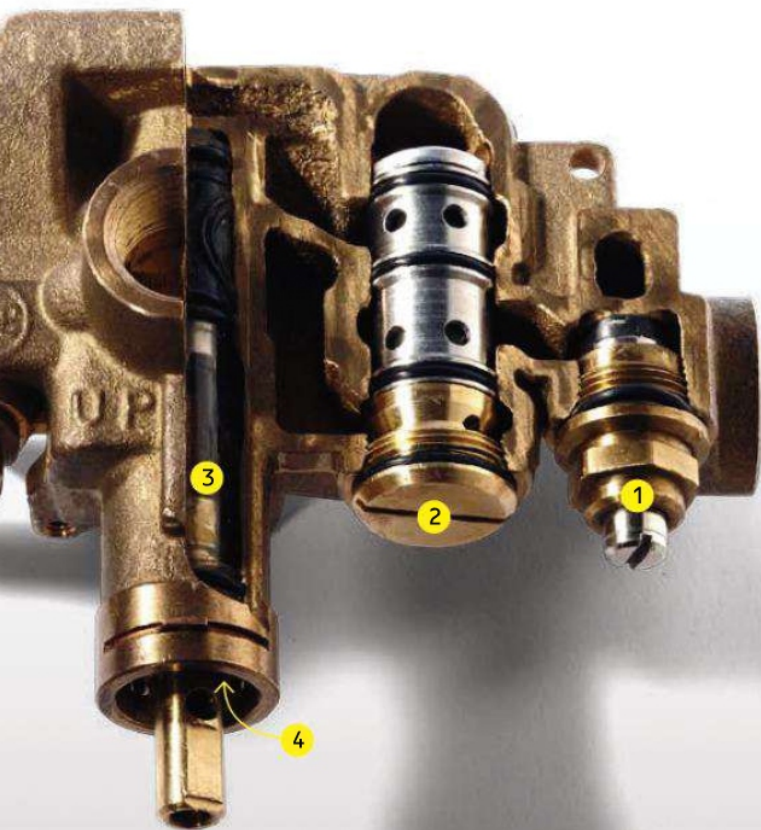
→ Lift and tilt the stopper, and angled hinges slip free. Use pliers to clean the stopper and the spring within the drain.



LIFT-AND-TURN DRAIN

→ Remove the knurled knob from the stopper's top and undo the screw beneath. Use pliers and scissors to get hair off the mount bar in the drain.

PHO



A pressure-balancing valve like Moen's 3570 Moentrol prevents a temperature swing in the shower when someone elsewhere in the house flushes a toilet or starts the dishwasher. This cutaway shows how internal valve mechanisms maintain consistent water pressure and temperature in turbulent conditions.

1 CHECK STOPS

Spring-driven gaskets at the valve inlets prevent high-pressure hot water from crossing the valve into a cold supply line or vice versa. (Hot water is at higher pressure in recirculation systems.) Screws in the stops shut off hot and cold lines at the shower for work on the valve cartridge.

2 PRESSURE-BALANCING SPOOL

Hot and cold streams slide a graphite-composite piston in response to fluctuating hot and cold water pressure. In 0.1 seconds, the piston (inside the chrome sleeve) seals or opens inlets to maintain balanced pressure

between the two flows, which are still unmixed. Lab tests to monitor internal movement show the piston constantly vibrating back and forth.

3 CARTRIDGE

Pulling the shower handle slides the cartridge forward, opening two inlets to let hot and cold water enter and converge. Turning the handle opens one inlet as it closes the other, allowing users to adjust the temperature.

4 TEMPERATURE LIMIT STOP

Screwed into the cartridge's rod, this stop prevents a child from fully opening the valve to a scalding-hot setting.



THE LATEST NEWS ON THE LOWEST FLOWS

EPA WaterSense regulations require shower heads to use less than 2 gallons per minute (gpm) to douse a 5 x 3-foot stall, while setting standards for pressure and coverage to ensure a satisfying shower, not a miserly trickle. Here's how three manufacturers hit the new specifications.

MOEN → Water rides on spokes like a bike wheel's to reach the perimeter of Moen's 8-inch-diameter Envi shower head, avoiding the dry zones common in early low-flow models.

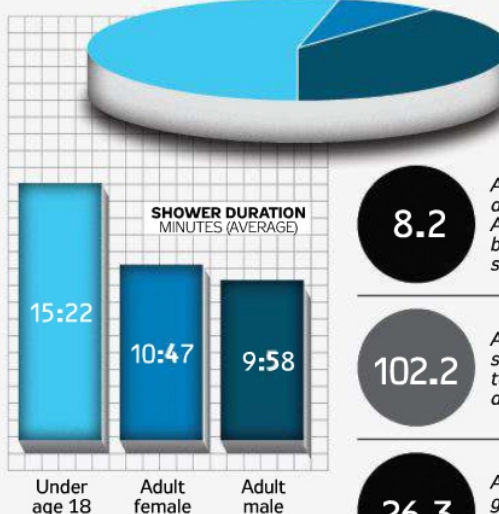
DELTA → A fat 0.26-mm droplet, twice the typical low-flow drop diameter, helps water in Delta's H₂Okinetic hold its temperature and feel like heavy rainfall.

KOHLER → Silicone polymers molded into distinct nozzle geometries let users set models like the Purist to deliver 1.75 gpm in a broad spray, a sharp beam or a wide deluge.

FIELD GUIDE TO AMERICAN BATHING

SHOWER SCHEDULE (AVERAGE)

58% MORNING
10% AFTERNOON
32% EVENING



8.2

Average age when Americans begin showering

102.2

Average shower temp. (F) for all adults

26.3

Average gallons of water used per shower

Sources: American Standard, Delta, Kohler, Moen, Russo Bros. & Co, 411plumb.com



STARTING OUT, STEPPING UP

seen plumbers drop the tank on the bowl with enough force to put a crack in it. I've done it myself."

Having installed more than a thousand toilets, Hart cautions that tanks are heavier—and more slippery—than many people expect. The toilet's position against the wall can make it difficult to get a good grip as you lower the tank into place. If need be, have someone help you install the replacement.

Once he has the tank where he wants it, Hart holds the bolt head steady with a long straight-blade screwdriver. Then he tightens the nut with a socket wrench. If there's too much threaded bolt shank to get a socket over the nut, he uses a ratcheting box-end wrench. "Move from bolt to bolt as you slowly tighten the nuts, and tighten them equally," Hart says. "Look at the space between the tank and bowl and make sure the tank is being pulled down evenly on all sides. Stop when you feel a fair amount of resistance and the tank is stable."

Summer Shutdown

We recently moved into a house with a whole-house Aprilaire humidifier system. What do we do during the cooling season? I assume the humidifier needs to be shut down. I notice that its air filter is covered with a white crust. Is that a sign that something's wrong with the system?

Yes, your humidifier needs to be shut off during the cooling season. When the humidifier is installed on a separate piece of ductwork, you'll notice a small lever nearby. It has to be adjusted to the summer setting so that the damper it operates is closed. If you look carefully, you'll probably find that someone has used an indelible marker to indicate the summer and winter positions of the damper lever. In most cases, when the handle's long axis is in line with the duct, the damper is open and allows humidification in winter. When the lever is perpendicular to the duct's long axis, the damper is closed for the summer cooling season.

The thing that you're referring to as the air filter is actually the humidifier's



→ My daughter Rachel is a young woman now, but I can still see her as a 9-year-old kid threading her way through a throng of leaf-raking

volunteers during a fall cleanup. She was carrying a diluted cup of coffee and brought it to me without spilling a drop. "Here, Dad," she said proudly. "I know you like a

cup of coffee, so I thought I would bring you one." My own career as a volunteer DIYer began one spring morning in 1968. My father, my brothers and I joined others to spruce up our church's grounds. There were shovels

and leaf rakes aplenty, and a weather-beaten Chevy truck with running boards we stood on as we rode loads of brush to the brow of a hill, where we dumped them. I loved every minute of it. Since then, there have been flood-ravaged houses to fix, another church with grass to cut, old houses to repair and weeds to pull. And these days, Rachel and her younger brother, Joe, do their own volunteering at a local hospital, so I have to get my own coffee now. PM editors and readers—and our kids—have the skills to make a real difference, and there's no time like the present: April 10 to 16 is National Volunteer Week.

evaporator panel. Water flows at a controlled rate onto the panel and clings to its absorbent coating, then evaporates into the air. The coating deteriorates, and mineral deposits are likely to form on it, accounting for the crust you describe. It doesn't indicate a problem—it's typical of a panel that's gone through one heating season. Simply replace the panel with an Aprilaire part, not a cheap knockoff.

You should also check that the plastic drain and supply lines leading to and from the humidifier are clear and not cracked. There may be other maintenance steps you need to take, depending on the humidifier model. For example, there are different types of water distribution trays that supply the evaporator panel. The tray may need cleaning. I'd go to the company's website and download the owner's manual for your model to find out what else you need to do at the end of the season or before the start of the next heating season.

PM



Got a home-maintenance or repair problem? Ask Roy about it. Send your questions to pmhomeclinic@hearst.com or to Homeowners Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.

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PIPE HANDLE

1

3

2

100-FOOT
EXTENSION CORD

+ ONE-DAY PROJECT

The Electric Bucket

KEEP LONG EXTENSION CORDS TANGLE-FREE WITH A PORTABLE DRYWALL-BUCKET REEL THAT SPOOLS IN SECONDS. BY WILLIAM GURSTELLE

1 → GET A BUCKET Acquire an empty 5-gallon drywall bucket, 1- and 4-inch-diameter PVC pipe, a 4-inch flat PVC end cap, pipe fittings to reduce the 4-inch diameter down to 1 inch, a 1-inch tee fitting, PVC solvent, a half sheet of ½-inch plywood and a 6-inch stamped metal turntable—all available at most big hardware stores. The final ingredient is a 100-foot, 12-gauge, grounded outdoor extension cord with a split three-way female receptacle.

2 → PREP THE BOTTOM Cut a piece of plywood to fit the square top plate of the turntable. Using machine screws, attach the plywood to the turntable's holes. Center the PVC end cap on the wood plate and attach with wood screws. Center the turntable end cap assembly in the bottom of the bucket and attach it with ¼-inch machine screws, washers and nuts. Attach an 18 x 18, ½-inch plywood square beneath the bucket bottom using nuts and ¼-inch machine screws.

3 → BUILD AND CEMENT Cut a 2-inch-wide slot in the bucket side with a saber saw. To prevent cord abrasion, line the slot with mitered pieces of 1-inch-diameter dowel, slotted along the length with a ½-inch-deep groove. Attach them to the bucket with 10 No. 4 machine screws, nuts and washers. Cut a 4-inch-diameter PVC pipe as long as the bucket is high; set the pipe into the end cap. Use a 4-inch-to-2-inch bushing to reduce the PVC pipe, then reduce it further using a 2-inch-to-1-inch reducing fitting. Make a handle from two 1-foot lengths of 1-inch-diameter PVC pipe and a 1-inch tee fitting. Test the assembly to make sure it spins easily. Cement the PVC and let it cure overnight.

4 → WIND THE CORD Thread the cord's male end through the bucket slot. Leave about 3 feet of slack to reach an outlet, and loosely tie the cord around the handle. Stand on the plywood base and turn the handles to spool the remaining cord around the central pipe. To unwind the cord, stand on the plywood base and pull the female end from the slot.

Tools Powered:
Shop vac, leaf blower
Cost: \$95 (with cord)
Coil Time:
47 seconds
Cord Tangles:
Zero

To be completely safe, unroll the cord fully before using it—even though a 15-amp tool won't noticeably heat up a 12-gauge cord.

+ MORE TO DO IN MAY

See Chair City → Hit furniture hub Thomasville, N.C., on May 4 for ECHO's Chainsaw Sculpting Invitational, where a dozen top carvers lop logs into benches, lighthouses, dogs, hillbillies and various forms of bears.

Tune the Mower → Art Sauerwin, who puts the A in Paducah, Ky.'s A&J Small Engine Repair, recommends replacing the mower's air filter and changing the oil to begin the season. As for oil choice, he says, "nothing less than SAE 30."

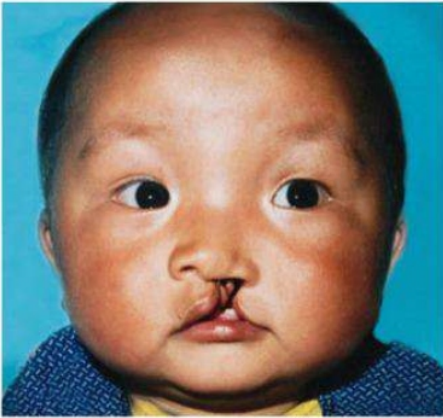
Fly a Kite → Larry Stiles of the Tulsa Wind Riders kite-flying club plans a "mass ascension" to kick off the 18th Festival of Kites on May 7. "See kites as small as a stamp; others as big as a house," he says. "It's spectacular!"

Sharpen Shears → Fix nicked blades on garden shears with a 6-inch file. Press the file flush against the cutting edge and slide it up the blade in one direction. When the blade shines, flip it and file off the burr on the inside edge.

Help Your Mama → Be a good boy on May 8. Go to your mom's house and clean the gutters, weed the garden, plant tomatoes and set up the window a/c unit. For easy bonus points, replace the shower head. And don't forget flowers.

Pick One. Just One.

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Ming, 6 months, China



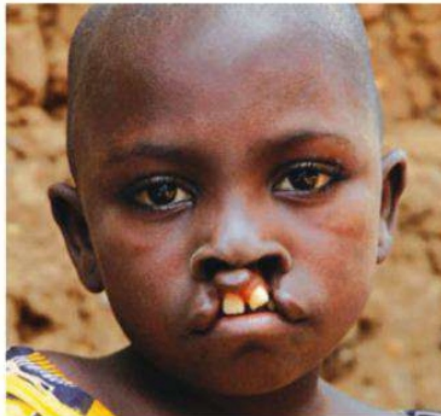
Shiva, 1 year, India



Mot, 13 years, Cambodia



Durgap, 5 years, India



Funmi, 8 years, Nigeria



Salazar, 5 years, Philippines

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diy

Auto

Saturday
Mechanic

Headlight Tech

BETTER TO LIGHT A SINGLE CANDLE THAN TO CURSE THE DARKNESS. BY MIKE ALLEN

➔ **I'm willing to bet** that drivers only think about headlights during one of two events: when for some reason they can't see at night, or when an oncoming car blinds them. Like the alternator, these critical pieces are overlooked—until they don't work. And that's a shame, because for the gearhead, there's a lot of interesting tech behind the glass. Like, for example, did you know that an HID headlight is like a lightning bolt in that a glowing arc of electricity illuminates the fixture? Plus, automakers are calling on headlights to increase not only safety but also fuel efficiency.

Knowing how your lights work will better prepare you to keep them maintained, so you're more likely to see that deer before it runs into your path. Besides, the rapid evolution of headlight tech is interesting in itself. Here's a primer.

SUPPORT
STRUT

QUARTZ GLASS

HIGH BEAM

LOW BEAM

SYLVANIA
SILVERSTAR
H13

INSIDE



THE LED FUTURE + BALL-JOINT BLUES + TOOL-RACK TIP

STUDIO D

The Old-Fashioned Way

→ **The first cars used** crude lamps fueled by either kerosene or (gasp) acetylene. About 100 years ago, the open flames were replaced with a small electric bulb housed between a polished reflector and a lens. These lights weren't sealed well, so the reflector corroded quickly, making the already insufficient lights even dimmer—and worse, they provided plenty of glare to oncoming traffic. These types of lights were made illegal in 1941, a scant year after the introduction of the sealed beam.

Sealed Beams

→ **A sealed-beam headlamp** is nothing different from a giant household bulb, a tungsten filament housed in a glass enclosure that's sealed and filled with inert gases. The reflector is inside the glass envelope. Like household bulbs, these gradually lose brightness as the tungsten evaporates from the filament and deposits on the reflector. Dippable high-and-low beams didn't come along until the '20s. Brightness and beam control in this era were inconsistent because of poor manufacturing tolerances. And the inside of the poorly sealed glass lens easily corroded, further reducing the brightness. Sealed-beam lights were cheap partly because they came in only three sizes—5- and 7-inch round and one square size—but more important, the standardized sizes limited styling differences among cars. Automakers started replacing sealed-beam lights with quartz-iodine technology in 1973.

Quartz-Iodine

→ **QI is the predominant** automotive lighting technology today. Legal in the U.S. since 1984, it uses a small bulb that resides inside a reflector/lens assembly. Thanks to modern sealing materials and techniques, the reflector is far less likely to corrode from moisture intrusion. The high-temperature quartz glass envelope allows the filament to remain at a much higher temperature, for a light that's closer to natural daylight. The higher temperature means a lot more light for the power consumed, but also makes the tungsten filament evaporate and redeposit on the glass, gradually reducing light out-

put. To combat this, halogen bulbs are filled with iodine or bromine rather than the customary inert gas. The halogen combines with the tungsten vapor coating the cooler glass, then disassociates when it touches the hot filament, basically redepositing the evaporated tungsten back where it started.

Manufacturing these cylindrical bulbs is very high-tech. After the filaments are sealed to the glass at the bottom, most of the air is evacuated from the top. While a propane flame

heats the neck in the top of the bulb to a semiliquid state, a jet of liquid nitrogen cools the base to minus 321 degrees F. Then a pellet of frozen gases is dropped in. Instantly, the hot, soft glass at the top is crimped, sealing the envelope. When the temperatures equalize and the gaseous pellet boils, the pressure inside rises to 4 to 5 atmospheres. The H13 high-low beam lamp shown in the lead photo is the industry's latest version. Computer vision systems carefully tweak the posi-



TECH

HEADLIGHTS: THE NEXT GENERATION

HID (high-intensity-discharge) lights are often installed as original equipment on high-end cars. But there are plenty of aftermarket conversions to be found (and even some ordinary quartz-iodine bulbs incorrectly labeled as HID; caveat emptor). These aftermarket conversions use an HID arc lamp and a ballast, just like the OEM kind, but are designed to retrofit into a conventional socket and reflector designed for quartz bulbs. They can be had for as little as \$75 a pair, substantially less than the OEM prices for factory-installed HIDs.

Unfortunately, the shape of the tungsten filament (of the original bulb) is different from the shape of the arc in the HID envelope, which makes the HID beam pattern of the assembly unpredictable. While you may be able to see fine, it will throw glare in odd directions, which will make it difficult for you to see in any kind of precipitation. It will also shine into oncoming drivers' eyes. Plus, these HID conversions are illegal, but purveyors get around that by labeling them "For Off-Road Use Only." Not recommended.

TUNGSTEN FILAMENT

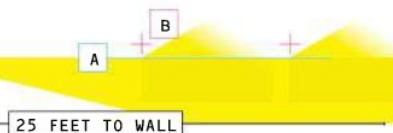
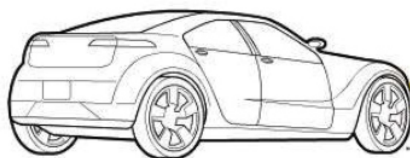


HID ARC



The tungsten filament in a conventional QI bulb has a square bright spot that cools off slightly at the ends, while the arc in an HID is an elliptical shape of near-constant brightness. To achieve the same beam pattern, they require different reflectors.

ADJUSTING YOUR BEAMS

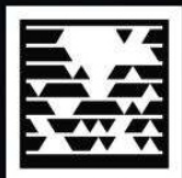


Proper headlight aim is critical. Check aim with a driver in the car and a full tank of gas. The low-beam cutoff (a) should be slightly below the center of the lens (b) to keep glare out of oncoming traffic and reduce the light reflection that occurs during rainy or snowy weather. The bend in the cutoff should be slightly to the right of the center of the lane, for the same purpose. This will illuminate the road surface in front of the car, as well as the curb area to the right.

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PERFORMANCE

PERFORMANCE



NEXT UP

LEDS

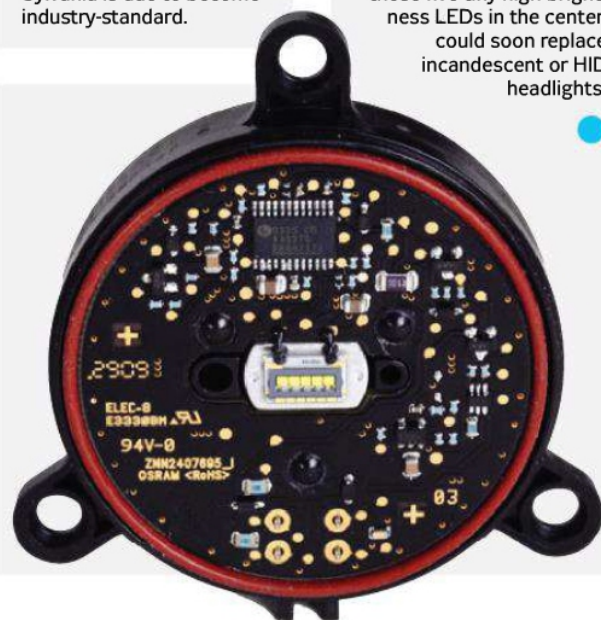
We already use LEDs for taillights, a practice started by Cadillac on the 2000 DeVille. Aside from giving engineers the ability to design lights with substantially different styling, LEDs consume very little energy and illuminate 400 to 500 milliseconds faster than an incandescent lamp, which provides that cellphone-chattin' texter behind you an additional 40 to 44 feet of warning (at 60 mph) that you're on the brakes.

While we wait for LED headlights to become commonplace, some DIYers might opt to switch their taillights to LEDs. Be warned: They draw so little juice that a conventional turn signal switch won't cycle—so if you choose to convert to LEDs, you'll need a different flasher relay that's not dependent on load, or to add ballast resistors to draw sufficient current.



This tail/brake lamp from Sylvania is due to become industry-standard.

This 2-inch lamp, with those five tiny high-brightness LEDs in the center, could soon replace incandescent or HID headlights.



tion of the filaments in each bulb as it's assembled, maintaining tolerances within 0.004 inch—which means replacing a lamp shouldn't require reaiming the headlamp. The high-beam filament sits at the precise focal point of the reflector, providing the best illumination up the road. The low-beam filament sits slightly off the focal point to spread the beam and establish a cut-off pattern to keep glare out of oncoming drivers' eyes. Some quartz-lamp systems rely on the use of a metal shield to provide the cutoff pattern.

The color of bulbs is expressed as a function of the temperature of the light

emitted. A QI bulb is around 3400 degrees K, as compared to natural sunlight, which is considered to be around 6000 K. Recently, we've started to see QI lights that have a blue-white color, not the usual warm yellow light. These are aftermarket bulbs with different filaments and glass coatings that attempt to emulate the blue hue of expensive high-intensity-discharge (HID) lights (I'll get to HID lights in a minute). While these bulbs do raise the color temperature, they don't get close to an HID's 5000-plus K color. Oh, and they don't necessarily raise the light output either. So what's the point? Style—it's one

PHOTOGRAPHS BY MARC ASNIN

way to spend \$20 and acquire the cachet of \$2000 HID lamps.

HID

➔ **HID bulbs don't** use a tungsten filament. Instead, they pass a high-voltage electrical arc through a partially evacuated chamber that's filled with noble gases and mineral salts. A ballast/igniter is necessary to provide the high voltage and high initial current, although once the bulb is started, it uses far less energy and gives off more light than the QI lamp. Plus, the arc projects a crisp beam, with an easy-to-manage pattern.

One disadvantage: It takes a few seconds for the arc to warm up to reach full output—that's a problem for using these bulbs as high beams, which need full brightness instantly. Some vehicles use HID low beams for their sharp cutoff and glareless light, and a conventional QI bulb for the high beams. Other high-end cars move a mechanical shroud inside the reflector to change the pattern of a single HID lamp to suit both patterns. Those work-arounds make these lights expensive—it's a \$500 to \$1000 option on some cars. Despite all that, Sylvania's director of aftermarket sales and lighting, Jim Sanford, says HID lamps will soon represent 40 percent of the OEM market share in the next three to five years, up from only a few percent.

The future belongs to LEDs, which are already in use in some brake lights. Manufacturers are just now figuring out how to use these devices for headlights (only the Audi A8 uses them so far). Since there has been no standardized LED bulb to plug into a reflector/lens assembly, car manufacturers have had to design a unique PC board for every model, an expensive proposition. No more. Sylvania has designed a universal tail/brake light bulb that's already used in the Mustang. When someone succeeds in doing the same for headlights, the LED's benefits—lightweight, vibration tolerance, long life and ultra-low power drain—will quickly make even HIDs obsolete. But that future is at least five years away.

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Car Clinic

by Mike Allen

Q+A

The Ball-Joint Blues

Q

I took my car in to get the oil changed, and the mechanic told me that the tie-rod end boot and the ball-joint boot on the right side were torn. The damage was probably a result of an off-road excursion—an intentional excursion, I might add—I made into some underbrush that was a little thicker and tougher than I thought. He wants to replace both, at a cost of hundreds of dollars. Can I save money and change these myself?

A It's not uncommon to cut or dislodge those small, vulnerable boots when you're out stump-jumpin'. The price you told me the mechanic quoted is for a full replacement of the parts on that side of the car, which involves not only disassembly, but removal of the factory riveted-in ball joint and a subsequent realignment of the front end. And he's right: This will fix your problem permanently, at least until the next hijinks in the woods.

Odds are you can game the system and replace just the torn boots with aftermarket pieces. Now, that assumes the suspension and steering parts are

still relatively fresh. You can buy the boots for a couple of bucks at the auto parts store. For the tie rod, simply remove the cotter pin and castellated nut, pop the old rod end down, replace the old boot and reinstall the castellated nut with a fresh cotter pin. Then pump in some grease and go. Oh, no grease fitting? Problem is, the replacement boot isn't as effective at keeping grease in and dirt out as the original. Now you have a decision to make, depending on the age and condition of the part. If it's worn out and you're just trying to make it through the remainder of the vacation, pack the new boot with some grease and go. When you get home, buy a new tie-rod end that has a grease fitting so you can add grease as appropriate. A relatively low-mileage rod end can be drilled to accept a fitting, so you can grease regularly.

Ditto for the ball joint, although replacing a ball joint on some vehicles—like yours—requires special tools or even a hydraulic press. Usually you can just pull the stud from the ball joint to the upright and slide on the new boot. It might take a set of spring compressors to unload the suspension to get the required clearance. If this all sounds complicated, it is. Seeing as you need both boots, I'd just let the mechanic do it and get the vehicle aligned (which it probably needs if you've been rock-crawling with it).



BOOT CAMP This simple rubber boot keeps the grease in and the dirt and water out of suspension and steering joints. Problem: Rubber boots are not that difficult to tear.



MIKE'S TOOLBOX

OVERHEAD TOOL RACK

Pneumatic tools take up plenty of space in a toolbox, far more than hand tools, which generally will lay flat in a relatively shallow drawer. So I came up with this rack for hanging tools in the PM shop. It's just an Ikea kitchen pot rack, not modified in any way. I suspended it so I can walk under it and not worry about banging my head, but it's not so high that I can't reach it easily—your height may vary. A lot of tools will hang easily enough by their own handles. A few, like the cordless drill, have a belt hook. And for a few others, I simply bent a slightly-greater-than-90-degree angle into a big fender washer and screwed the air-line fitting through it. The fender washer doesn't get in the way at all, and I've never had anything jump free.

Attention-Getter

I have a 2000 Buick Century V6 with a horn that just won't shut up! I removed the steering wheel pad and the horn button wiring from the steering wheel. *Honk!* I replaced the relay. *Honk!* The relay terminal (from the switch) is always hot. Removing the horn relay or fuse horn is the only way to prevent it from blowing continuously. The Haynes manual schematics do not even show a wiring diagram for the horn circuit. The car has a remote fob for lock/unlock/trunk, and the car is supposed to "beep" when locked/unlocked. Is the receiver bad? I can't pass inspection without a functioning horn!

I looked up your schematic online at alldatadiy.com. There are only two wires leading to the pull-in pin on the horn relay, both black. One leads to (duh) the horn switch in the steering wheel, the other to the Body Control Module, which honks the horn for the remote locking system. One of them is shorted to ground. Yes, ground, because the relay coil is hot all the time and is activated by grounding the other end of the coil. To determine which wire is shorted, you might need to cut them short of where they meet at the relay spade lug.

I'm guessing it's the one from the steering wheel, which has moveable electrical contacts in the turn signal canceling switch. I'll bet one of the contacts has slipped or there's a foreign piece of conductive material in there grounding it out. And I do hope you're taking all due precautions with the airbag when you're working on the wheel, because if you accidentally set it off, it can kill you. Dead.

Your Cheatin' Pipe

As a mechanic in a diesel shop, I was helping a trusted fellow mechanic torque connecting rods with a $\frac{3}{4}$ -inch torque wrench (click type). I suggested using a pipe (cheater bar) to lengthen the lever arm and make tightening easier. He said doing so would affect the torque wrench's accuracy. I had helped a different (also trusted) mechanic do the same thing and we had used a pipe in that application, with the same torque wrench. It seemed to work that time. Can you shed some light on this and explain the physics behind it? (I am not talking about adding an extension to the ratchet end.)

A conventional, straight extension between the socket and the torque wrench's ratchet will have no effect on the measured torque.

Using an extension on the handle of a clicker-type torque wrench shouldn't affect the readings, although I'd consider it serious abuse of an expensive, calibrated tool.

Now, that same extension on the handle of a simple bending-beam torque wrench will affect the readings, because that handle is supposed to pivot around a pin in its center. Slipping a pipe over it will bend the beam from a different centerpoint, altering the relationship between the beam and the socket and making the applied torque read out incorrectly. Best solution: Get a torque wrench that's got a longer handle, or a torque multiplier that goes between the socket and wrench, basically a little planetary gearbox. Or just go to the gym more often.

Pass It Along

I have a 2001 Ford Escape. After about three or four years, the LED in the radio quit working regularly—after the warranty ran out, naturally. Now, for some reason, it comes on more often, but the LED is very dim. The Ford dealer told me that they don't work on radios, so they would have to send it out, but here's the problem: They said that even if it's just a loose wire, they would probably charge me \$225 to fix it or even just look at it. Any ideas?

Flaky displays are a common complaint on those particular radios. Car dealers and auto repair shops generally don't fix stereos; they just remove them and send them out to a specialty shop. Save some money and do that yourself.

A 10-minute search gave me the websites for a half-dozen places that will fix your radio—no matter what is wrong with it—for a hundred bucks or so. If you're not Web-savvy, try the Yellow Pages.

Don't feel comfortable pulling the radio yourself? Get some neighborhood teenager, one who's got a car with one of those window-shattering stereos, to pull out the radio so you can box it up and ship it off.

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PM DIY /// CAR CLINIC Q+A

Where Do They Come Up With These Ideas?

Several months ago, I came across some Internet articles regarding using your car as part of a portable generator. The article talked about installing rollers for the drive wheels—like a dynamometer—which would drive the generator. Have you seen such an apparatus? Comments?

Most chassis dynamometers are set up this way, with a pair of rollers driving a generator to load the wheels. The electricity in this case goes to a big resistive load cell instead of being captured and used, so the technology is simple. And not cheap.

At any rate, unless you're driving a big honking generator, the car engine will be operating at a very inefficient rpm/throttle combination. There are also substantial energy losses in the driveline and between the tires and the rollers. Fuel burn per kilowatt-hour of energy generated will be something like double or triple what you would get from just running a conventional generator. Not to mention the size of the fixture the rollers would have to be mounted in. You'd have to have a roller that is driven by *both* drive wheels, or the car's differential would fail within minutes. It's not designed to let one wheel spin while one is stationary.

Bottom line: This sounds like a really awkward way to turn a \$25,000 car into a \$500 generator that gets crummy fuel efficiency.

Missing Link

I carefully check the gas mileage on my 2007 Prius, listing gas to three decimals and filling to the exact same pump cutout every time. I now have 60,200 miles. I change the oil myself with Mobil 1 every 5000, and the air filter each 20,000 miles. I use gas from the same station most of the time. After getting 50 mpg consistently until reaching 58,000, why would mileage drop to a consistent 42 to 43 mpg?

To really figure this out, I'd start by hooking up a scan tool and checking that all is right. One thing to look at is the coolant temperature—the car will perform poorly if the thermostat is keeping the engine too cold, although that should set a trouble code and turn on the Check Engine light. Also look at the short-term and long-term fuel trim. A good mechanic who knows Toyotas should be able to figure this out. My best guess? A fuel injector that's carboned up and not spraying properly, or a lazy oxygen sensor. You've driven just about the mileage where either is likely. A couple of tankfuls of injector cleaner might help if the injector is clogging.

As for the lazy oxygen sensor, check the crosscount rate, which will be abnormally low if the sensor is getting decrepit. Okay, I feel your pain: I'll explain crosscount. Oxygen sensors put out in the vicinity of 0.8 volts when the mixture is rich (more fuel than can be burned with the available air), and 0.2 volts when the mixture is lean (excess air). The engine computer constantly slues the mixture back and forth from a touch lean to a touch rich to stay right near the 14.7:1 stoichiometric "perfect" air/fuel ratio. If the sensor is lazy, or contaminated with carbon or even some silicone from silicone spray applied underhood or some RTV bathtub caulk used on an air-cleaner pipe, it gets slow. Instead of taking 100 milliseconds or less to swap from low to high or back, it gets slower. Eventually it gets so lazy that the engine computer can't accurately meter fuel—and your fuel mileage tanks. (Sorry.)

A longer shot to explain declining fuel economy is a bad high-voltage battery pack, but those seem to be lasting a lot longer than 60,000 miles, with some in taxicab service reporting over 200,000 miles.

Stuck on You

Would you have any advice on how to remove a Garmin base that's been affixed to my dash with adhesive? We'd like to trade the car without showing a big mess on the dash.

First off, I'd never stick one of these things on my dash if I ever wanted to remove it. The plasticizers in the vinyl will migrate into the adhesive, so even if you can remove it

successfully, the vinyl under it will be more likely to crack and discolor as the plastic ages under the influence of UV light and environmental ozone.

But too late now. On a day that's not too cold, remove the base itself by sawing it off with a piece of monofilament fishline or dental floss tied between two ballpoint pens or tongue depressors. This will leave at least some of the adhesive on the vinyl. Remove this with Goo Gone, being careful not to rub very hard. The Goo Gone will remove all the shine from the surface, so follow up with a sparing coat of low-gloss protectant over the entire surface to blend it in. If you have a lighter dashboard and the color has changed, you're basically out of luck.

For your next car, look into a different style of mount. I usually use a suction-cup mount on the window. If that doesn't work for you, there are mounts that hook into the blades on the a/c vents, or that come up from the floorboards on a stalk.

Paint It Black

I have a black Grand Prix GT, and I would like the wheels to be the same color. But I would prefer not to spend a ton of money on new wheels, so I was thinking about painting them. Does this really work? I mean, work well? And if so, how would one go about doing this properly? What tools and type of paint would one need?

The stock alloy wheels on your Grand Prix—and virtually all other OEM and aftermarket street wheels in production today—are already painted. So the hard work of cleaning them up and priming them is already done. To do a quality job, you really, really should remove the tires from the wheels; there's no way you can mask off and clean up the tires. Wash the wheels thoroughly to remove any brake pad dust, dirt or vestigial road salt. Scotch-

Brite the surface thoroughly to provide a toothy surface the paint can stick to. Degrease with paint-prep solvent; then, using a spray gun, apply ordinary automotive paint followed by a clear coat. These paints are professional products, not forgiving of mistakes and, by the way, toxic. I'd recommend removing and prepping the wheels, and having a professional painter do the spraying, cough, cough.

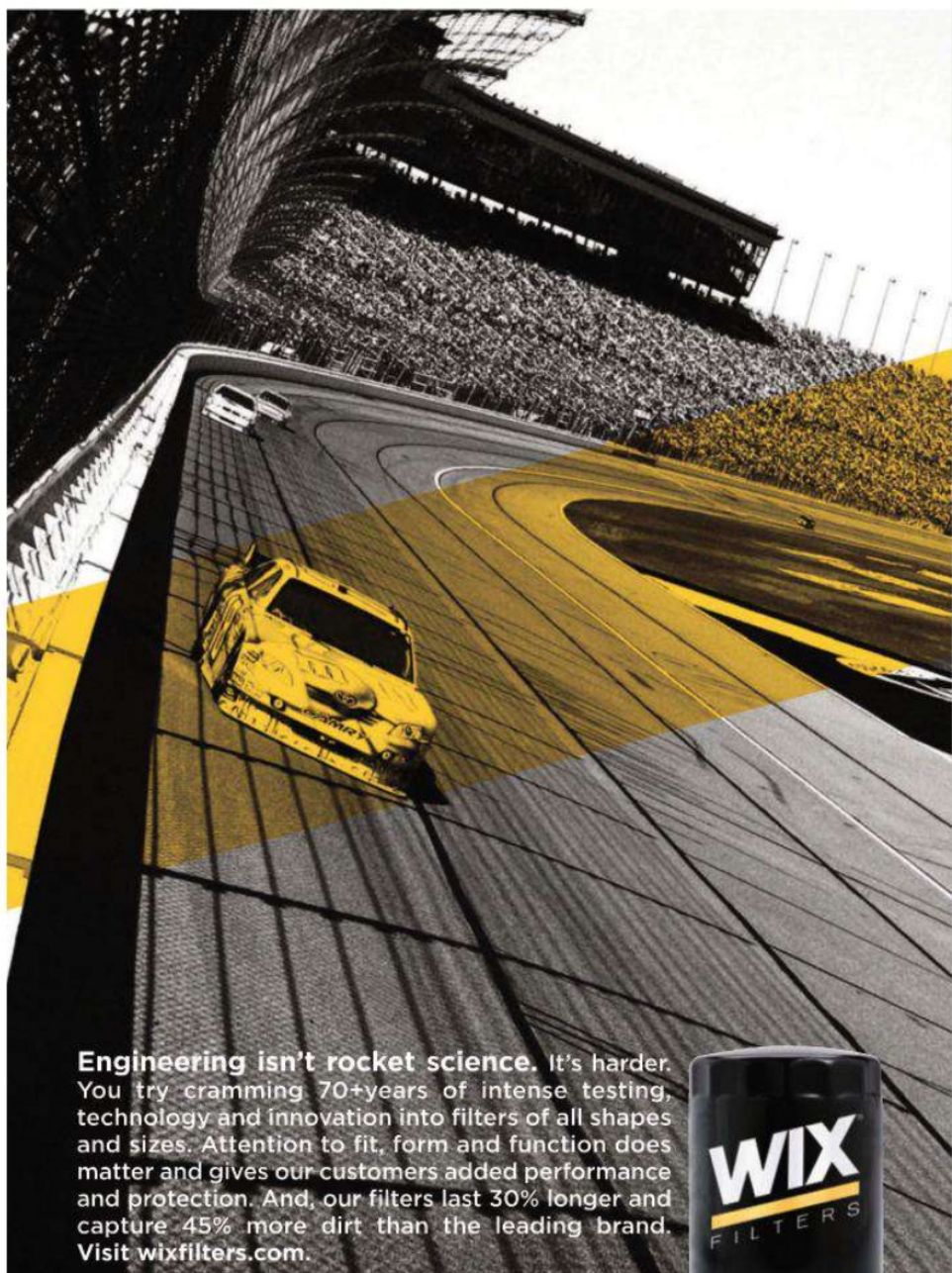
Uh-oh—pro-grade spray gun/spray job not in the budget? You can do an okay job with spray cans, but not with

the fast-drying lacquer-based aerosols intended for paint touchups. The auto-paint store, the one where all the body shops order their supplies, should be able to provide you with some automotive enamel in an aerosol can. If you prefer a satin black rather than a high-gloss finish, Eastwood (eastwood.com) has a satin black wheel paint in an aerosol can that's perfect. Odds are you really want a dark gray color, not a true black, and Eastwood and Dupli-Color both sell an appropriate paint in a rattle can.

PM

Got a car problem?

Ask **Mike** about it. Send your questions to pmautoclinic@hearst.com or over Twitter at twitter.com/PopMechAuto or to Car Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.



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Tech

SMARTPHONE

Modern phones, such as this T-Mobile myTouch (\$250), have GPS and Internet connections, making them perfect for geocaching.

GPS HANDHELD

Still the gold standard for outdoor enthusiasts, dedicated devices such as this Magellan eXplorist GC (\$150) have built-in maps and special geocaching features.

LOGBOOK

Every cache contains a physical logbook in which cache hunters chronicle their visits on-site. Later, they enter the information online.

GEOCOINS

These medallions can be any shape or size, and are placed in geocaches as trophies or registered online as trackable objects.

TRAVEL BUGS

These are the most common kind of trackable object in geocaching. They are registered online and meant to be moved from cache to cache.

CONTAINERS

There is no standard geocaching container—they can be small “nanocaches” like a film canister, or large caches like this ammo box.

Geocaching

THIS GLOBAL GAME COMBINES HIGH-TECH NAVIGATION AND OUTDOOR RECREATION. BY GLENN DERENE

➔ **Hidden in the framework** of a classic New England covered bridge in Pittsford, Vt., there is a Tupperware container with a surprise inside. I know this because I put it there. That Tupperware container is a geocache, and, along with the surprise, it has a few standard contents—a logbook, a Travel Bug and a Chirp radio beacon. If you know what those things are, then you have already been initiated into the geocaching community. If you're not familiar with those terms, then

INSIDE

✕ GROUP TEXTING + MOBILE TRANSLATION + AIRPLANE WI-FI

STUDIO D

Sluggish? Low Energy? No Libido?

Low Testosterone?

News is sweeping through the U.S. about a natural pill that can help boost libido while enhancing muscle mass and energy! And it works by pumping your body's own testosterone levels – *naturally!*

by Mary Klein

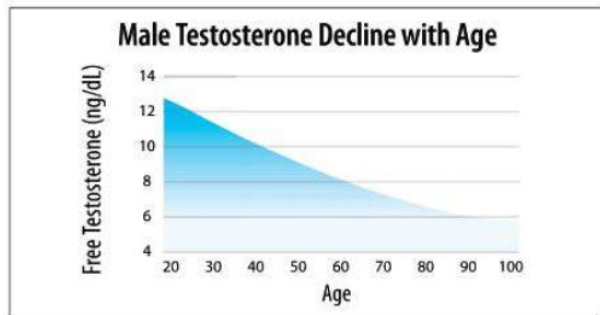
Scientific researchers have finally discovered a new natural compound that attacks the nasty symptoms of male menopause and helps make men strong, sexy and virile again.

Scientifically formulated

The research on this revolutionary compound is so impressive that it has been added as the key active ingredient in Vitali-T-Aid™ by Naturade® and it's going to catch the attention of men across the country. Research indicates the active ingredient works at the cellular level to revitalize free testosterone levels in the bloodstream. In human clinical studies conducted under strict "double-blind" scientific testing protocols, researchers are reporting astonishing results.

With just two capsules a day, the compound in Vitali-T-Aid™ actually helps to increase the body's free testosterone, boosting it by an average of 98% in just six weeks. These results are nothing short of staggering.

The proprietary ingredient in Vitali-T-Aid™ is like a natural pick-me-up, producing higher levels of testosterone triggering a cascade of energy, promoting muscle growth when exercising, and increasing sex drive. In fact, 85% of the clinical trial group reported an improvement in sexual desire and performance in just 21 days!



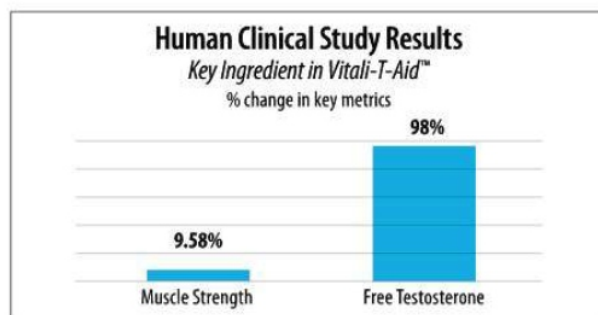
Vermeulen, A. (1996). Declining androgens with age: an overview. In Vermeulen, A. & Odgers, & B. J. (Eds.), *Androgens and the Aging Male* (pp. 3-14). New York: Parthenon Publishing.

How Vitali-T-Aid™ fights sexual aging

According to WebMD as many as 25% of U.S. men suffer from the affects of low testosterone levels or androgen deficiency. Symptoms of low testosterone include decreased sex drive, lack of energy, loss of muscle mass and increased body fat.

Testosterone naturally declines with age as the body's production begins to slow down. In fact, the average 70 year old man produces only half the testosterone of a 20 year old, while others may experience even more drastic declines.

The key ingredient in Vitali-T-Aid™ helps raise free testosterone naturally, triggering a range of miraculous benefits from increased libido to supporting muscle mass and mood. It's no surprise that patients with restored testosterone levels often report a "Lazarus effect," waking them up from a zombie-like state of fatigue, low sex drive and depression.



These clinical study results used double-blind, placebo controlled methodologies and were conducted on human subjects for the primary active ingredient in Vitali-T-Aid

The reason many men over 40 are weak, flabby and lethargic may be due to the decrease in their testosterone levels, which is often ignored by conventional medicine.

By supporting healthy levels of testosterone, researchers report that men enjoy more energy, strength and virility, produce a stronger physical response, and experience stronger libido and stamina, giving men and their partners more satisfying love lives.

Men all around the country are enthusiastically taking Vitali-T-Aid™ –from athletes to grandfathers– and report feeling revitalized and a renewed sense of well being.

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PM DIY TECH /// GEOCACHING

you are probably a "muggle," and in all likelihood, you've been unknowingly walking by a world of hidden treasures for years.

Geocaching started in the year 2000, just after selective availability was removed from the Global Positioning System (GPS). In the early days of GPS, the government instituted purposeful inaccuracy for civilian navigation devices, as a national security precaution. When that inaccuracy was lifted, consumer-grade GPS devices became useful for tracking and pinpointing objects to within 30 feet—and a global game of hide-and-seek was born. Today, there are geocaches hidden in more than 100 countries (Afghanistan has 186 caches), and caches can be found in areas both populated (there's one on New York City's 56th Street between Broadway and Seventh Avenue) and unpopulated (Denali National Park in Alaska has several). The community prides itself on clever placement, and there are entire subgenres of extreme caches—underwater, in caves, on top of mountains, in trees, on islands, etc.

What separates geocaching from a run-of-the-mill scavenger hunt is the integration of technology. The tech is twofold—geocachers use GPS navigation devices to find their quarry, and sophisticated online databases to organize, find and share the location data. In many ways, geocaching integrated the phenomena of social media and location-based networking long before most people had heard of either. Before GPS, a hobby called letterboxing was the equivalent of geocaching sans GPS, but caching with modern technology lowers the barrier to entry for newbies, and amps up the challenge for experts who want to do some serious backcountry navigation.

Community Service

➔ **There are several** community sites for geocachers. Some sites, such as navicache.com and gpsgames.org, are simple database search engines with awkward interfaces and dated designs. Far more sophisticated are sites such as

EXTREME GEOCACHES



Deepest Underwater:

Rainbow Hydrothermal Vents, 7500 feet below the Atlantic near the Azores

Coordinates: N 36° 13.800
W 033° 54.200



Highest in the Sky:

International Space Station, in orbit 220 miles above Earth

Coordinates: Depends when you ask



Coldest:

Near the South Pole, Antarctica

Coordinates: S 89° 59.517
W 008° 54.821



Tallest Mountaintop:

Peak of Mt. Whitney, 14,505 feet above sea level in Sequoia National Park, Calif.

Coordinates: N 36° 34.731
W 118° 17.571

geocaching.com and opencaching.com, which is the newest entry. Started by GPS-device-maker Garmin, Opencaching has a slick interface and is open-source, so anyone could create software that plugs into its database. But so far, the only GPS devices that natively work with the opencaching.com site are Garmin's own.

Geocaching.com may not look as polished as its main rival, but it has the largest, richest database around and is the clear center of gravity for geocaching culture. Users must register with the site. A basic membership is free and provides access to the coordinates of existing caches. The site allows these users to upload comments on found caches and post new caches. Premium membership costs \$30 per year and allows subscribers to create custom maps and rank caches for the rest of the community. Groundspeak, the company behind geocaching.com, also sells logbooks, waterproof boxes, trackable objects and other geocaching-related gear, but none of that stuff is required for the player who wants to create and hide a geocache.

The major outdoor-GPS-device manufacturers (Garmin, Magellan, DeLorme and Lowrance) have embraced geocaching, and many GPS handhelds have special submenus dedicated to the pursuit.

Garmin, Magellan and DeLorme have also created browser plug-ins that allow users to upload caches to their GPS handhelds directly from geocaching websites. The standard data format for cache information is a .gpx file, which includes location data as well as a text description of the cache. Navigational devices can both store and add to .gpx files, so you can log and comment on a cache you find out in the field, then upload that information back to the geocaching site you use.

As is the case with many portable electronics, the functionality of stand-alone GPS handheld navigators is easily translated to, and arguably improved upon by, smartphone apps. Since smartphones generally have GPS antennas built into them, as well as access to maps, they can perform the same basic navigation duties as dedicated GPS handhelds. And, because they can access off-board data via cellular networks, cache files don't need to be pre-loaded onto the device, and updates on geocaches can be logged online directly from the field. Dozens of geocaching navigation apps are available for the iPhone as well as Android and BlackBerry devices, but the gold standard for usefulness comes from Groundspeak. That company's \$10 geocaching apps for iPhone and Android have an even slicker interface than the geocaching.com website itself, potentially freeing cachers from any need to go indoors. As great as smartphone geocaching apps are, however, they do have two flaws: First, the maps and interaction with online cache databases require a cellular signal, which can be a problem when hunting down remote caches. Second, smartphones are hardly ruggedized devices, so before you take them out into rough terrain, you might want a shockproof and waterproof case from a company such as Magellan or OtterBox.

Cache Culture

➡ **If the concept** of gadget-assisted exploring interests you, it's worth noting that geocaching is as much a cultural as a technological phenomenon. Cachers are a welcoming bunch who are willing to provide helpful advice to newbies, but they also clearly relish the secrecy of the

world they inhabit. They even seem to feel a bit of kinship with the wizards of the Harry Potter books, as evidenced by the borrowed slang term muggles, for noninitiates. A creatively designed or well-placed cache can earn plenty of pats on the back in a cache's comments section, and there are some detailed guidelines on cache placement intended to discourage bad behavior. For instance, no caches should be placed on private land without permission of the owner, and they should never be buried. Geocaches should generally not be placed on school property or military bases. They should be at least 528 feet apart. And no geocache should deface public or private property. The restrictions ease off once you rise above the stratosphere, though: Geocaches are expressly permitted in outer space. (There is one on the International Space Station.)

Treasure Trove

➡ **Aside from a logbook**, the contents of caches vary widely. Geocache containers should generally be weather-resistant, and the stuff inside should never be dangerous or perishable. The contents of some geocaches launch another level of geo-game. Some "multi-caches" hide the coordinates and hints for a second cache inside the first—creating a chain-reaction search. Some caches contain Travel Bugs, Geocoins or other trackable objects that users move from cache to cache (each trackable has a dedicated website that chronicles its journey). Last year, a new technology was added to geocaching when Garmin started selling \$23 Chirp beacons. These send out periodic messages to compatible devices using a short-range wireless signal.

Some critics consider geocaching littering—an accusation that the community has addressed with its Cache In, Trash Out initiative. Some caches have caused confusion with authorities, leading to their destruction by bomb squads. Most caches, however, last for years and can get dozens, if not hundreds, of visitors. In fact, by the time you read this, my cache in Vermont most likely will have been found already by a cacher who will add his own surprise—another contribution to the hidden world.

PM

GOES PLACES NAILS AND SCREWS WOULDN'T DARE.



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Digital Clinic

by Seth Porges

Q+A



A Yeah, I was skeptical of the whole idea at first, too—the potential for mischief just seemed too great. However, while easy access to mass texting might sound like a spammer’s dream—and a consumer’s nightmare—the services aren’t just for ruthless marketers. After extensive use of GroupMe, my favorite group-texting service, I can safely say that it is a remarkably effective way to keep in touch with a group of people who are traveling or attending an event together. Buddies on ski trails can use it to coordinate slope-top meet-ups; large families can use it to meet for lunch after a morning spent fanned out across Disney World; and an eight-piece ska band can use it to coordinate whatever it is an eight-piece ska band does.

Here’s how GroupMe works: One person sets up a “group” of text recipients using either a Web interface at groupme.com or a mobile app (there are currently iPhone and Android versions available), then adds friends by inputting their names and phone numbers. Once the group is set up, GroupMe gives it a unique phone number that, when texted by any person in the group, passes on the message to everybody else.

The whole thing sounds simple, but in practice it teeters toward the magical, thanks to two strokes of genius. First, because interactions occur through text messages, your friends with iPhones,

Mass Messaging

I’ve heard about group-texting services that make it easy to send text messages to multiple people at once. Not being a professional spammer, why would I want to do this?

Android handsets, BlackBerries and 10-year-old Nokia bricks can all play along. Nobody needs to download any apps (although doing so does add a few features, such as the ability to view a map showing the physical location of your friends), and no phone is too dumb to use the service. And second, because messages are tagged with the name of the sender, the whole thing quickly starts to resemble a virtual, take-anywhere chat room—especially if your phone has threaded text messages.

Of course, there are a few problems with the whole concept of group texting. Because other people can add you to groups without your permission, you can easily find yourself the recipient of a large number of unwanted text messages. Thankfully, GroupMe gives users a way out of this: If you don't want to be part of a conversation, simply text back "#mute", and the messages will cease. Then there's cost—although the service itself is free, if you don't have an unlimited texting plan, GroupMe could very quickly eat up your monthly allotment. So texter beware.

Sky-High Wi-Fi

I recently got the chance to use the Gogo Inflight Internet service. It worked great through most of the flight, but as we started our descent, it stopped working, and I got a message telling me that the service may not work at altitudes below 10,000 feet. Why is this?

Blame the FCC and FAA, which forbid the use of any electronic devices by pas-

sengers below 10,000 feet, where they presumably could interfere with ground-based communication or navigation systems. (Whether it's actually a risk is a topic of much debate, but that's an argument for another time.) To keep our electronics-craving temptations at bay, Gogo Inflight Internet is outfitted with a kill switch of sorts—when a plane dips below this altitude, the Wi-Fi goes kaput.

In case you were wondering, it's actually pretty cool how in-flight Internet services such as Gogo work. Their sky surfing is facilitated by ground-based cellphone towers that are positioned to broadcast a signal up to the sky rather than across the earth. The undercarriage of the plane is outfitted with receivers designed to pick up the signal, which is then pumped out through the cabin over Wi-Fi. The result isn't quite as fast as your home cable connection (speeds are closer to those of mobile broadband hotspots), but it's more than enough to pass the hours of a cross-country flight—and to kill your last excuse for not responding to your boss's e-mails. **PM**

Babel App

I reread *The Hitchhiker's Guide to the Galaxy* and was reminded of the sci-fi series "Babel fish," which allowed people to understand any language just by slipping the aquatic creature into their ear. With all the crazy new mobile apps out there, surely one of them can pull off a trick like this. Right?



While scientists have yet to discover any sort of real-life translation fish (and honestly, I'm not sure I'd want to use it if they did), technology has brought the idea of instant translation firmly into reality. Sure, Google Translate can handle text in most common languages as fast as you can copy and paste it, but perhaps the neatest tech translation tool is the Word Lens app,



The Word Lens app uses a phone's camera to translate Spanish signs into English.

which makes use of a phone's camera to translate Spanish-language signs in real time. Load up the app, point the camera at that south-of-the-border sign or text, and the phone's screen shows the same sign—in English. Great for emergencies when you might forget what *baño* means! And if that weren't neat enough, the program also goes the other way—translating English signs into Spanish. Cool.

The app is far from perfect. Because it produces a literal, machine-like translation,

there's plenty of opportunity for *Lost in Translation*-esque antics. The app also has trouble recognizing some custom fonts.

Word Lens is currently available only for the iPhone, but its developers tell PM that they hope to produce an Android version soon (maybe even by the time this issue arrives in your mailbox). And although the app is free to download, you'll need to spend \$10 on an in-app purchase to activate either its Spanish-to-English or English-to-Spanish translation abilities.

Got a technology problem? Ask Seth about it.

Send your questions to pmdigitalclinic@hearsst.com or over Twitter at twitter.com/sethporges. While we cannot answer questions individually, problems of general interest will be discussed in the column.



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his wife Dolly this morning. He was flying home from a vacation and the weather got bad and he lost control of the plane."

AUGUST'S GRUESOME TOLL continued to climb. By the end of the month, 13 plane crashes had left 12 people dead across the state. It was as if Ted Stevens's dream had died with him.

A few weeks later, I flew to Alaska to talk with some of the state's most experienced pilots and administrators. Among them was an early adopter of ADS-B technology, a 30-year-old Inupiaq Eskimo named Lee Ryan. A third-generation pilot, Ryan comes from a family that has long embraced aeronautical technology. His great-grandfather used to deliver the mail by dogsled from Unalakleet, on the Bering Sea, to Kaltag, 70 miles inland on the Yukon River. When airplanes came along, his son, Ryan's grandfather, realized that by air he could accomplish in an hour what took a dog team four days.

Today, Lee Ryan is the chief pilot of Ryan Air, the company that his grandfather founded. He oversees a fleet of 13 aircraft that serves 76 native communities spread across an area the size of the eastern United States. "Flying here isn't a luxury, it's a necessity," Ryan says. "I'm not here to prove my manhood. If there's a way to make my job safer, I'll take it."

On the day I visited Ryan at one of his company's hangars in Anchorage, a huge low-pressure system was parked over the Bering Sea, sucking in howling winds that were gusting to 40 mph. On Lake Hood, the float-plane basin next door, tiny whitecaps marched toward shore. Ryan was keen to demonstrate his fleet's latest avionics in action, but the rules he himself established specify that the company's four Cessna 207s must remain on the ground when the wind is gusting more than 35 mph. Instead, we pushed one of the planes out onto the ramp so the ADS-B system could get a signal from the satellite fleet.

As the wind rocked the airframe, Ryan toggled through the features on

the plane's Apollo MX20 multifunction display. He hit a button and the computer screen showed every aircraft within range carrying ADS-B or transponder equipment. He hit another button and we had a satellite weather display of precipitation in the region. The next screen displayed in red every place within 5 miles that was less than 300 feet below the altitude of the plane. "It gives us outstanding situational awareness," Ryan says. The plane Terry Smith was flying was equipped with an alert system that warned of dangerous terrain, but the NTSB could not determine whether it was working.

Of course, it's not enough to have the best information possible; you have to use it intelligently. That afternoon, when I returned to Lake Hood, I noticed a pair of pontoons 50 feet offshore. Sitting atop one of them was a wet, chagrined-looking man. Another man bobbed in the water. A moment later, fire engines and police cars roared up, and a pair of rescue boats motored toward the capsized plane. It turned out the men had been trying to take off when the fierce winds upended their aircraft.

NOT EVERYONE WHO WANTS TO IMPROVE Alaska's safety record looks to technology. That same week, I drove north from Anchorage to the town of Birchwood, where I met 50-year backcountry veteran Terry Holliday. A former neighbor of Graybill's, he specializes in the kind of wild and woolly aviation that John Graybill introduced me to. Holliday sometimes touches down where no plane has ever landed: tundra, beaches, gravel bars. Electronics are useless for takeoffs and landings in those settings, he told me. The only things that can keep a pilot alive are skill, judgment and experience. "I've survived all these years without technology," says Holliday, who has never had a major accident. "I'm not against it, but for my kind of flying, it's not going to do me any good."

On a bright, calm morning, Holliday took me for a ride in the back seat of his Super Cub. We'd barely begun to roll down the runway at Birchwood Airport when the plane leapt from the tarmac and rose up over the tree line, revealing a rolling carpet of golden birches that stretched toward the Chugach Mountains. Soon we were flitting over the gravel bars of the Knik River, heading for the great sprawling mass of the Knik Glacier. Another plane, piloted by Holliday's friend Tom Atkins, flew alongside, carrying photographer Julian Dufort.

Fifteen minutes later, we were at the base of the Knik Glacier. Holliday descended until we were flying low over a luminously blue stretch of water choked with car-size chunks of ice. On one side rose a vertical rock face; on the other, a sheer wall of blue ice. Holliday drove down the gap like a cabbie down Park Avenue. It was one of the most breathtaking experiences I'd ever had, but if the engine failed, there would be only two possible outcomes: quick and hot or slow and cold.

The engine held, and Holliday swooped up and banked sharply, diving and landing on mud flats beside a glacial lake. We climbed out, our hair ruffled by the cold katabatic wind flowing down over the ice. High above us, mountain goats stood out as white dots on a looming rock face. Standing in this spot was the best argument I could think of for bush flying. So, if technology is not the way to make this kind of flying safer, I asked Holliday, what is?

"Common sense," he answered. "It's not something you can teach. You need a certain amount of luck and you need a certain amount of experience. If you get away with something once, you have to be smart enough not to try to get away with it twice."

CLEARLY, JOHN GRAYBILL DID NOT SHARE that sentiment. According to the NTSB's preliminary report, the 79-year-old was flying his Super Cub near McGrath, west of Denali, with his wife, Dolly, and his dog, Halla, in the backseat. A friend, John Bath, was flying behind in his own Super Cub with his wife, Ellen. As the weather began to deteriorate, Bath decided to turn back. Graybill pressed on—risking what may have been VFR into IMC. "Buddy, are you still with me?" Graybill called over the radio. Those were his last known words.

Pilot friends of Graybill's speculate that as the clouds closed in around him,

he remained confident that he'd be able to find a way through. When he finally ran out of room, he spotted a hole in the clouds below and dove for it, only to find that he'd flown into a bowl too small to escape from. In his first near-fatal mishap a half-century earlier, he had dodged a similar trap; now it had snapped shut for good.

True to form, Graybill wasn't using GPS or ADS-B. His emergency locator transmitter was off. When the rescue team located John's and Dolly's bodies, they found that neither had been wearing a seatbelt.

A LOT OF PEOPLE WOULD HAVE AN EASY LABEL for that kind of behavior. Reckless. Crazy. Stupid, even. Certainly Graybill was a man who lived his life with little regard for convention. And he paid a terrible price—not so much with his own death, which was something he and many others expected, but with that of his 78-year-old wife.

I've been a pilot for nearly a decade, but every time I preflight an airplane I think about dying. I tell myself that the more aware I am of the potential fatal mistakes, the less likely I am to make one. But I know that the risk is still there. And that awareness gives flying an intense edge. I've seen incredible things from the cockpits of small planes—spouting whales, sandstone pinnacles, the Sierra Nevada mountains at sunset—and in each case the memory is shot through with the knowledge of the price I could have paid.

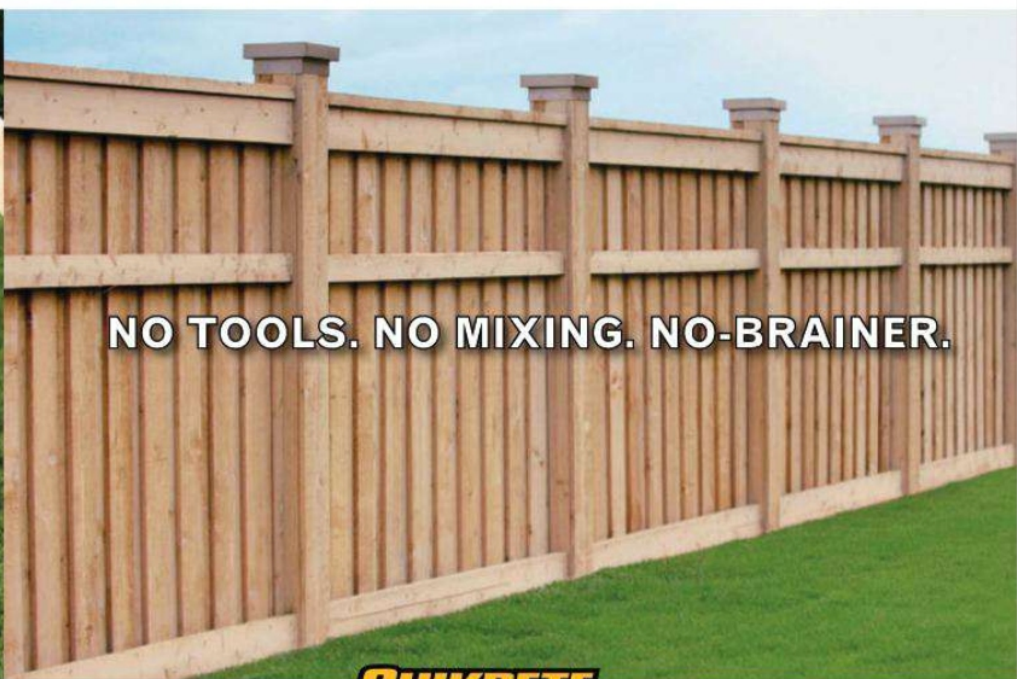
In an age of electronic marvels, we tend to look to technology to solve our problems. When it stands in for expertise, however, it puts itself between us and the world around us. It mediates and insulates. At its best, technology can empower. There is no one freer than a pilot in Alaska with an airplane. When you take off, you can have thousands of square miles entirely to yourself. There is no mediation. It is a matter of you, your machine and the wilderness. And that's pure freedom.

A few weeks after Alaska's horrible month drew to a close, I rented a small airplane at Anchorage's Merrill Field and flew south toward Soldotna. Climbing over

the city limits, I crossed Turnagain Arm and headed across an uninhabited expanse of the Kenai Peninsula. To my left rose the dark flanks of the Kenai Mountains. Far to my right, the rugged coast of Cook Inlet stretched to the south. No sign of human presence was visible except a pipeline cut near the foot of the mountains. If I lost engine power, there would be no safe place to put down.

The plane was more than 25 years old, and equipped with neither ADS-B nor GPS. The engine droned on; the landscape inched past, darkened by a thickening overcast. I felt entirely alone in the world, a sensation both exhilarating and frightening. In the distance lay a silvery shape that was marked on my chart as Skilak Lake. A highway ran north of it, where I could make a survivable landing. Based on my airspeed indicator, it would be within gliding range in 10 minutes.

I checked the fuel gauge, the oil pressure, the tach. They looked good. For now I'd done all I could to reach my destination safely. Everything beyond that was out of my hands. **PM**



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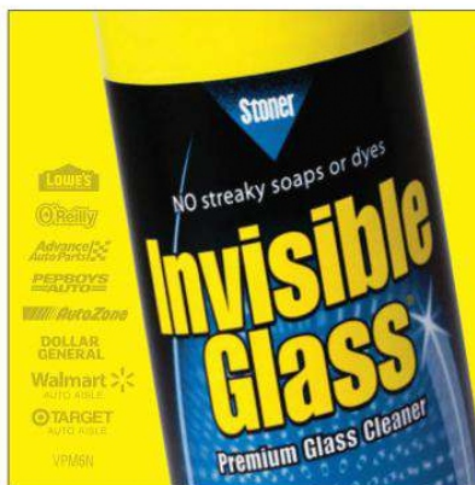
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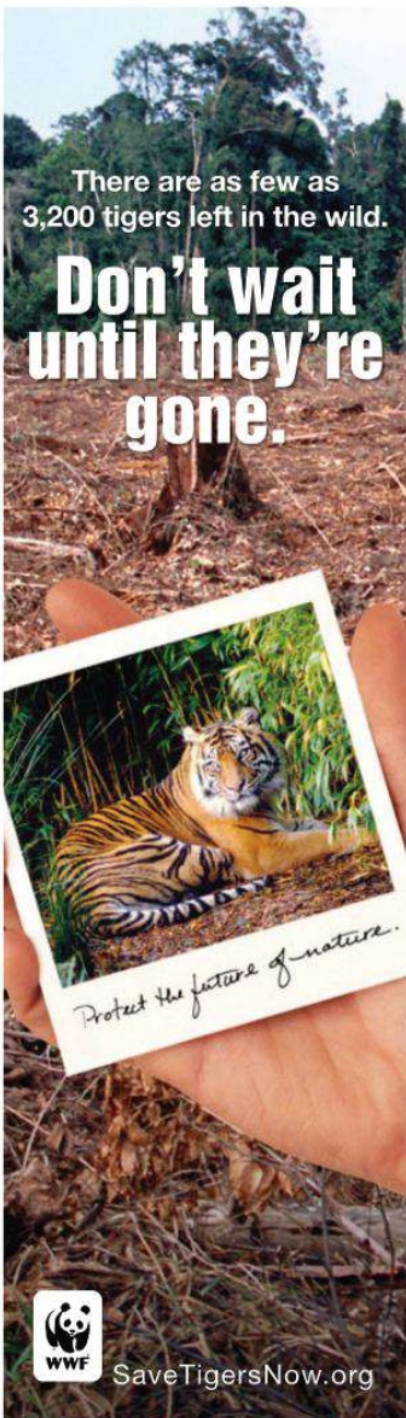
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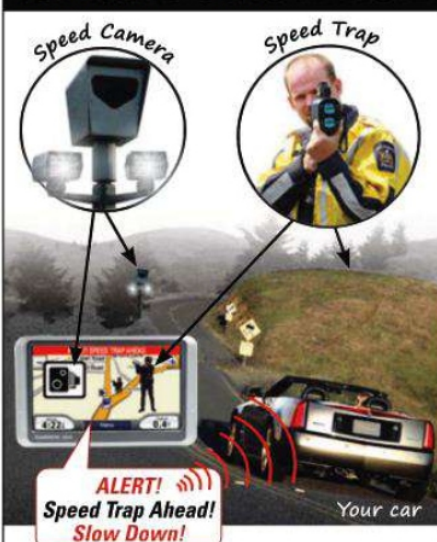
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Name: CARL MEHLING
Location: NEW YORK, N.Y.
Age: 42
Years on Job: 16



Behind a secure, unlabeled door in a back hallway of the American Museum of Natural History (AMNH), Carl Mehling catalogs fossils in the Big Bone Room. The area houses more than 200 bones from more than 45 species of dinosaur on open shelves and in locked cabinets. It is always kept at approximately 65 degrees F and 50 percent humidity because "small existing cracks can grow bigger over time," says Mehling, who studied zoology and paleontology, and started at the museum as a volunteer 21 years ago. He also participates in digs; on one trip, he became the first person to lay eyes on fossil embryo skin while examining eggshells at a sauropod nesting site in Argentina. "Skin is hard to find because the fossil record favors hard parts," he says. "That site is the only place fossil embryo skin has ever turned up." — ERIN MCCARTHY



1., 2. *DIPLODOCUS LONGUS* BONES

These bones—respectively, the posterior dorsal and presacral vertebrae of a 90-foot-long herbivore—are from the first fossil dinosaur collected by the museum in 1897. Written on the fossils is "AMNH FARB 223," their catalog number within the museum's fossil reptile collection. This ID allows Mehling to access information such as when and where the bones were found. "Without its data, a fossil loses much of its scientific value," he says. "It's just a pretty rock."

3. *BAROSAURUS* BONE

This real cervical bone from the 86-foot-long *Barosaurus* was used to make a cast for the museum's display skeleton. "We often favor casts because they're faster and safer to mount," Mehling says. "Plus, unmounted specimens are easier for researchers to study." Up to 200 researchers visit the collection each year; those who want to move a fossil from its location must fill out a yellow tag. "One part of the tag follows the specimen, and one stays," Mehling says, "so we know who took it and who we need to talk to when we don't find it."

4. CAST SKULL

Before the museum's *Apatosaurus* skeleton went on display 106 years ago, it was missing a head. So researchers sculpted one using this cast skull, from other sauropods like the *Camarasaurus*, as a guide. "It was like putting a cat's head on a dog's body," Mehling says. AMNH kept the model after a more accurate cast was made. "We're obsessed with the past," he says. "Even our own interpretations get archived."



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